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Comparison of Growth and Haemoglobin Concentration in Exclusively Breastfed Infants for Four Months Compared to Six Months, with and without Iron Supplementation in Khartoum State

By

Dr. Suad Mohammed Ali

M.B.B.S (U of K)

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Supervisor

Dr. Ziedan Abdu Ziedan

MD

Dedication

With much love and respects.. I dedicate this research to ..

My Mother

My Husband

My sons and my daughter

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In the name of Allah, most Beneficent, most Merciful.

I would like to express my profound gratitude to Almighty God (Allah) for all the physical and mental strength He bestowed on me during the execution of this research and the preparation of this dissertation.

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Abbreviations

WHO: World Health Organisation.

FAO: Food and Agriculture Organisation.

UNICEF: United Nation international Children's Emergency Funds.

UNDP: United Nation Development Programme

BFHI: Baby Friendly Hospital Initiative.

NGOs: Non Governmental Organisations.

MOH: Ministry of Health.

UNFPA: United Nation funds for Population Activities.

UAE: United Arab Emirates.

HIV: Human Immunodeficiency Virus.

OMH: Omdurman Maternity Hospital.

EDTA: Ethylene Diamine Tetra acetic Acid.

ANOVA: Analysis of Variance

SD: Sudanese Dinar.

ABSTRACT

Background Information: Exclusive breastfeeding for six months was recommended by the WHO in its declaration in the year 2002.The Sudan had been practicing exclusive breastfeeding for four months until the year 2004 when it has adopted the Geneva Declaration of exclusive breastfeeding for six months.

Study Design: This study is a randomised and blinded clinical trial, following infants and mothers for six months. It is a facility and community based study.

Study Settings: The study group was selected from Omdurman Maternity Hospital. The mothers were instructed to exclusively breastfeed their infants. At the age of four months, the infants were divided into two main groups; one group continued exclusive breastfeeding for six months while the other group introduced food. Half of the infants in the first group were given iron supplement, while the other half was given a placebo. At the age of six months the infants' growth was assessed using parameters of weight and length. The Hb concentration was evaluated for the whole group.

The Objectives: The objectives of this study were to assess growth, Haemoglobin concentration and iron supplementation in infants exclusively breastfed for six months and to study socio-economic factors affecting them in Khartoum State in 2005.

The Results: At the age of six months the weights of infants who were exclusively breastfed for six months were found comparable to the weights of infants who were allowed to have food at the age of four months. The lengths of the two groups showed no significant difference although those infants who were exclusively breast fed for six months gained more length. There was no significant difference in the incidences of infants having weights less than -2 sd in the two

groups. Exclusive breastfeeding for six months did not expose infants to low weights when compared to those provided with food at the age of four months.

Comparing the three groups (Group A which was allowed to have food at four months of age, Group BPb which continued exclusive breastfeeding to six months of age and were given placebo, and Group BFe which continued breastfeeding to six months of age and were given Iron supplements) showed no significant difference in haemoglobin concentration at the age of six months. Exclusive breastfeeding for six months did not compromise Hb concentration of the study infants. Food supplementation and iron supplementation did not improve the Hb concentration as well. The risk of having low Hb concentration was similar in all groups.

The results cannot be isolated from the environment surrounding these infants. In comparing the education of the mothers using the weight as the dependent variable, it was found that the growth of infants exclusively breastfed for six months was not affected by the level of education of the mothers. While the growth of infants supplemented with food at the age of four months was influenced with the education. The growth improved with the increase in the level of education of the mothers.

The economic status of the families had some impact on infants' growth. The infants of low economic status showed lower weights than those of high economic status. The impact was more marked n those provided with food at the age of four months than the infants exclusively breastfed for six months. The family size had no effect on the growth of infants exclusively breastfed for six months.

The Conclusion: Infants could be exclusively breastfed for six months with out faltering of growth or compromising the haemoglobin concentration and no need for food supplementation.

The economic status of the families and the education of the mothers had impact on exclusive breastfeeding, thus families of low economic status need support, guidance and encouragement.

ملخص الدراسة

خلفية عن الدراسة: إن الرضاعة الطبيعية المطلقة لمدة ستة أشهر قد أعلنت من قبل منظمة الصحة العالمية منذ عام 2002م . لقد مورست الرضاعة الطبيعية المطلقة لأربعة أشهر في السودان حتى تبني الرضاعة الطبيعية المطلقة لستة اشهر عام 2004م.

تصميم الدراسة: هذه الدراسة عبارة عن تجربة اخذت فيها العينة عشوائياً مع إخفاء طريقة التدخل الإختباري وتمت متابعة الأم والطفل لمدة ستة اشهر.

إنشاء الدراسة: قد تم إختيار مجموعة الدراسة من الأطفال حديثي الولادة في مستشفى الدايات بأمدرمان بعد موافقة الأمهات على الرضاعة الطبيعية المطلقة .بعد مضي أربعة أشهر على الرضاعة الطبيعية المطلقة تم تقسيم الأطفال إلى مجموعتين. الأطفال في المجموعة الأولى سمح لهم بتناول الطعام ، و أما الأطفال في المجموعة الأخرى فقد طلب من أمهاتهم مواصلة الرضاعة الطبيعية المطلقة حتى عمر ستة أشهر، هذه المجموعة من الأطفال قد تم تقسيمها إلى مجموعتين صغيرتين، مجموعة تم إعطاءها حديد والأخرى شراب خالي من الحديد وذلك لدراسة أثر الحديد في نسبة الهموقلوبين لدى الأطفال.

أهداف الدراسة: تقدير النمو ونسبة الهموقلوبين وأثر إعطاء الحديد للأطفال الذين رضعوا رضاعة طبيعية مطلقة لمدة ستة أشهر مع دراسة الأحوال الإجتماعية والإقتصادية التي تؤثر على الأطفال موضوع الدراسة في ولاية الخرطوم عام 2005م .

نتائج الدراسة: بعد مرور ستة أشهرمن الرضاعة الطبيعية المطلقة تمت دراسة المجموعة الكلية من حيث الوزن ، الطول ، ونسبة الهموقلوبين. ولم تظهر نتائج هذه الدراسة أي فرق في النمو بين الأطفال الذين تم إرضاعهم رضاعة طبيعية مطلقة لمدة ستة أشهر، و الذين سمح لهم بتناول الطعام في عمر أربعة أشهر. و لم تؤثر الرضاعة الطبيعية المطلقة لستة أشهر على نسبة الهموقلوبين بصورة واضحة و لم يوجد فرق بين من رضع رضاعة طبيعية مطلقة لمدة ستة أشهر و من أكل أو أعطي الحديد في عمر أربعة أشهر . وقد تبين كذلك أن تعليم الأم له أثر على نمو الأطفال ، فالتعليم المتدني للأمهات يؤثر سلباً على نمو الأطفال الذين رضعوا رضاعة طبيعية مطلقة لأربعة أشهر و يقل الأثر على الأطفال الذين رضعوا مطلقاً لستة أشهر.

الخلاصة: توصلت هذه الدراسة إلى أن الرضاعة الطبيعية المطلقة لمدة ستة أشهر كافية للأطفال ولا حاجة للطعام قبل ذلك وأن النسبة المتدنية للحديد عند هؤلاء الأطفال تحتاج لمعالجة الأمهات قبل الولادة. أما مستوى الدخل المتدني فله أثر سلبي على كل الأطفال حتى سن ستة أشهر ، وعليه حتى تستطيع هذه الأسر إرضاع أطفالها رضاعة طبيعية مطلقة تحتاج الأمهات إلى الدعم ، و التشجيع ، و النصح.

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1. INTRODUCTION & LITERATURE REVIEW

1.1. Introduction

Appropriate feeding practices are of fundamental importance for the survival, growth, development, health and nutrition of infants and children everywhere. In the light of this, the optimal duration of exclusive breastfeeding is one of the crucial public health issues that the World Health Organization (WHO) keeps under continual review. There has been consensus on the need for exclusive breastfeeding; however, there has been considerable debate on its optimal duration (1).

In the developing-country settings, the most important potential advantage of exclusive breastfeeding for six months – versus exclusive breastfeeding for four months followed by partial breastfeeding to six months – relates to the incidence of infectious diseases, morbidity and mortality, especially that due to gastrointestinal infection (diarrhoeal diseases). It also confers several benefits on the infant and the mother. However in some infants there are several potential risks with exclusive breastfeeding for six months, including growth faltering, iron deficiency and other micronutrient deficiencies. In all circumstances, these risks must be weighed against the benefits provided by exclusive breastfeeding, for four months followed by partial breastfeeding to six months (1).

1.2. Background Information

Health authorities advocate breastfeeding as the best method of feeding infants as it provides optimal nutritional, immunological and emotional benefits for the growth and development**. E**xclusive breastfeeding (1) is recommended for the first few months of the infant life since breast milk is the best food for optimal growth (2)**.**

Exclusive breastfeeding, as defined by the World Health Organization (WHO), refers to the practice of feeding only breast milk (including expressed breast milk) and allows the baby to receive vitamins, minerals or medicine. Water, breast milk substitutes, other liquids and solid foods are excluded (2).

Healthy newborns enter the world well hydrated and remain so if breastfed exclusively, day and night, even in the hottest, driest climates. Nevertheless, the practice of giving infants water during the first few months—the recommended period for exclusive breastfeeding—persists in many parts of the world, with dire nutritional and health consequences (3).

Depending on temperature, humidity, and the infant's weight and level of activity, the average daily fluid requirement for healthy infants ranges from 80–100 ml/kg in the first week of life to 140–160 ml/kg between 3–6 months. These amounts are available from breast milk alone if breastfeeding is exclusive and unrestricted (on-demand day and night) for two reasons:

1. Breast milk is 88 percent water.

   The water content of breast milk consumed by an exclusively breastfed baby meets the water requirements for infants and provides a considerable margin of safety. Even though a newborn gets little water in the thick yellowish first milk (colostrum), no additional water is necessary because a baby is born with extra water. Milk with higher water content usually "comes in" by the third or fourth day (3).

2. Breast milk is low in solutes.

   One of the major functions of water is to flush out, through the urine, excess solutes. Dissolved substances (for example, sodium, potassium, nitrogen, and chloride) are referred to as solutes. The kidneys—though immature up to the

age of approximately three months—are able to concentrate excess solutes in the urine to maintain healthy, balanced body chemistry. Because breast milk is low in solutes, the infant does not need as much water as an older child or adult (3).

Water in breast milk exceeds the infant's water requirements in normal conditions and is adequate for breastfed infants in hot, dry climates. Studies indicate that healthy, exclusively breastfed infants in the first six months of life do not require additional fluids even in countries with extremely high temperature and low humidity. Solute levels in the urine and blood of exclusively breastfed babies living in these conditions were within normal ranges, indicating adequate water intakes (3).

Replacing breast milk with a fluid of little or no nutritional value can have a negative impact on an infant's nutritional status, survival, growth, and development. Consumption of even small amounts of water or other liquids can fill an infant's stomach and reduce the baby's appetite for nutrient-rich breast milk. Studies show that water supplementation before the age of six months can reduce breast milk intake by up to 11 percent (3). Glucose water supplementation in the first week of life has been associated with greater weight loss and longer hospital stays. Water and feeding implements are vehicles for the introduction of pathogens. Infants are at greater risk of exposure to diarrhoea causing organisms, especially in environments with poor hygiene and sanitation. In the least developed countries, two in five people lack access to safe drinking water. Breast milk ensures an infant's access to an adequate and readily available supply of clean water .Exclusive breastfeeding means giving only breast milk. This means no water, liquids, teas, herbal preparations, or foods through the first six months of life. It was found that women do not take the advice "do not give water" applied to herbal teas or other fluids. So it is important to name

the drinks and foods commonly given in the first months. The practice of giving water and other liquids such as teas, sugar water, and juices to breastfed infants in the first months is widespread throughout the world. Studies in several communities reported that over 60 percent of newborns were given sugar water and/or teas (3). Cultural and religious beliefs influence water supplementation in early infancy. Proverbs passed from generation to generation advice mothers to give babies water. Water may be viewed as the source of life—a spiritual and physiological necessity. Some cultures regard the act of offering water to the newborn as a way of welcoming the child into the world. .The reasons given for water supplementation of infants vary across cultures[3]. Some of the most common reasons are:

- Necessary for life
- Quenches thirst
- Relieves pain (from colic or earache)
- Prevents and treats colds and constipation
- Soothes fretfulness

The advice of health care providers influences the use of water in many communities and hospitals. For example, in a Ghanaian city it was found that 93 percent of midwives thought that water should be given to all infants beginning on the first day of life (3). And in the Sudan many nurses and some doctors advise mothers to give sugar water after delivery. So health care providers and community volunteers need to be informed and convinced that breast milk meets the water requirements of an exclusively breastfed baby for the first four to six months of their lives. This could be achieved by highlighting these simple facts:

- Breast milk is 88 percent water.

- Every time a mother breastfeeds, she gives her baby water through her breast milk.
- Breast milk has everything a baby needs to quench thirst and satisfy hunger. It is the best possible food and drink that can be offered a baby. An infant's stomach is small and therefore when the baby drinks water, there is less room left for the nourishing breast milk that is necessary for the infant to grow.
- When a mother thinks her baby is thirsty, she should breastfeed immediately. This will give the baby all the water that is needed.
- The more often a woman breastfeeds, the more breast milk is produced, which means more water for the baby.

In addition to the hazard of introduction of water, there is the belief that breast milk alone is nutritionally insufficient after four months. This belief combined with the fact that complementary foods given in many developing countries are inadequate and contaminated, lead to concern about weanling's syndrome. The belief of inadequacy of breast milk for energy requirements beyond four months was initially based on calculations made by the Food and Agriculture Organization (FAO) and (WHO). Later studies done in the eighties have shown that the FAO and WHO figures substantially over estimate true energy requirements in infancy and that breast milk can satisfy the infant requirements (4).

Growth faltering is a common phenomenon in the developing countries after three months of age. This growth faltering had been attributed to (a) the belief of inadequacy of breast milk after three months.(b) poor nutritional quality of complementary food given.(c) infections .But now there are strong evidences that growth faltering is due to the short duration of exclusive breastfeeding and the wrong

feeding practices (4). So prolong exclusive breastfeeding, even in the developed countries, ensures proper growth, protection against infections and reduction of chronic conditions. Until recently WHO and UNICEF recommended exclusive breastfeeding for 4-6 months, with the introduction of complementary foods thereafter. Now the two organizations are more precise in recommending exclusive breastfeeding for six months.

1.3. Statement of the Problem

There are a number of issues that are important for policy-making with regard to defining the optimal duration of exclusive breastfeeding and maximizing its benefits. In The Sudan as one of the developing countries, exclusive breastfeeding for six month must be studied comparing it to exclusive breastfeeding for four months in terms of growth, iron stores and the need for iron supplementation, so that the benefits and risks can be assessed and weighed in relation to the socioeconomic factors affecting the Sudanese families.

1.4 Objectives:

1.4.1. General Objectives

To assess growth, haemoglobin concentration, the effect of iron supplementation and the socioeconomic factors of infants exclusively breastfed for six months compared to those exclusively breastfed for four months in Khartoum State 2005.

1.4.2 Specific Objectives

1. Monitor velocity of growth - in term of weight and length - of infants exclusively breastfed for six months and those exclusively breastfed for four months to the age of six months.

2. Compare the growth of both groups using the Z-score of weight-age, length-age and weight-length at the age of six months.
3. Compare the Hb. Concentration of infants exclusively breastfed for six months with those exclusively breastfed for four months and with those exclusively breastfed for six months and given iron supplements.
4. Determine the contributing factors affecting growth and Hb concentration of infants exclusively breastfed for four months and those exclusively breastfed for six months.

1.5 Justification of the Study

This research question of this study is to compare exclusive breastfeeding for six months to that for four months and given complementary food thereafter in terms of growth, Hb concentration and iron supplementation and the factors affecting them. The study was carried out to help the local health authority to gain greater insight into the impact of exclusive breastfeeding for six months on infants' growth and the family settings that might affect it. The results might encourage researchers to conduct more studies in this area.

1.6. Hypothesis

1. There is no difference in weight and height between infants exclusively breastfed for six months and those breastfed exclusively for four months and supplemented with food thereafter.
2. There is no difference in Hb concentration between infants exclusively breastfed for six months and those exclusively breastfed for four months and supplemented with food thereafter.

3. The Hb concentration of infants exclusively breastfed for six months and given iron supplements is better than the Hb concentration of those exclusively breastfed for six months and not given iron supplementation.
4. There is no difference in Hb concentration between infants exclusively breastfed to six months and not given iron supplementation and those exclusively breastfed to four month and supplemented with food thereafter.

1.7. Literature Review

1.7.1 Historical Review

Malnutrition has been responsible, directly or indirectly, for 60% of the 10.9 million deaths annually among children under five. Well over two thirds of these deaths, which are often associated with inappropriate feeding practices, occur during the first year of life. Only 35% of infants worldwide are exclusively breastfed during the first four months of life (5).

Poor feeding practices are a major threat to social and economic development and they are among the most serious problems facing infants to attaining and maintaining health.

The health and nutritional status of mothers and children are intimately linked together. Improved infant and child feeding begin with ensuring the health and nutritional status of women since mothers and infants form a biological and a social unit. They both share problems of ill health and malnutrition (5).

Nutrition is a crucial, universally recognized component of the child rights as stated in the Convention on the Rights of the Child. Children have the right to adequate and safe nutritious food. Women, in turn, have the right to proper nutrition,

to decide how to feed their children, and to full information that will enable them to carry out their decisions (5).

Breastfeeding is the best way of providing ideal food for the healthy growth and development of infants. Even though it is a natural act, breastfeeding is at the same time a learned behaviour. All mothers can breastfeed provided they have accurate information, support within their families and from the health care system. But the rapid social and economic change worldwide intensifies the difficulties that families face in feeding and caring for their children. These changes include the expanding urbanization which results in more families with uncertain incomes, the self employed and nominally employed rural women who face heavy workloads with no maternity support and the complex problem of population displacement, food insecurity and armed conflicts. The result of all these changes is a dramatic increase of the number of food insecure rural and urban households. The instability of these households lead to erosion of traditional family and community support structures which lead to reduction of resources devoted to supporting health and nutrition_ related services and eventually lack of provision of accurate information on optimal feeding practices (5).

In the sixties, many paediatric text books recommended introduction of breast milk substitute between six to twelve weeks to meet the dietary requirement of rapidly growing infants, especially in undernourished communities (6). Studies carried out in India and other developing countries showed that early introduction of supplements did not improve growth but increased the prevalence of morbidity and mortality. In addition to this, too early introduction of supplements may reduce milk production and thus shorten the duration of lactation.

In the seventies the public health specialists recognised the adverse consequences of the growing erosion on the traditional breastfeeding on infant health and nutrition especially in developing countries. So a global educational effort was initiated to promote the practice of prolonged breastfeeding (6).This effort was conducted by the WHO which reviewed the global data on infant feeding practices in 1989 and consensus recommendations were incorporated in lnnocenti Declaration (199O) 6 which stated that "As a global goal for optimum maternal and child health and nutrition, all women should be enabled to practice exclusive breast-feeding from birth to 4-6 months. Thereafter children should continue to be breast fed while receiving appropriate and adequate complementary food for up to two years of age and beyond". As lnnocenti Declaration did not clearly indicate four or six months as the appropriate duration of exclusive breast-feeding, many health professionals preferred to err on the side of caution and advise introduction of supplements by 4 months. This might be responsible for the relatively short duration of full breast-feeding among those who have access to health care (6).

Launched in 1991, the Baby-Friendly Hospital Initiative (BFHI) which was an effort by UNICEF and the World Health Organization to ensure that all maternity centres became local leagues of breastfeeding support. Since the BFHI began, more than 15,000 facilities in 134 countries have been awarded Baby-Friendly status. In many areas where hospitals have been designated Baby-Friendly, more mothers are breastfeeding their infants, and child health has improved (7).

Six million lives a year are being saved by exclusive breastfeeding, and global breastfeeding rates have risen by at least 15 per cent since 1990, the time of the Innocenti Declaration on the Protection, Promotion and Support of Breastfeeding (8).

Between 1990 and 2000, exclusive breastfeeding levels for children under six months in the developing world have increased by as much as three or fourfold in some countries. UNICEF, (WHO) and other child survival partners hailed this progress as they commemorated the adoption of the landmark Innocenti Declaration. But the Innocenti partners warned that the original goals of the Declaration are still far from met (8). For instance, only 39 per cent of infants in developing countries are exclusively breastfed. Lack of awareness amongst mothers, and lack of support from health workers and communities, is largely to blame. So the global strategies to promote and protect exclusive breastfeeding aim at the creation of national structures for the implementation of the International Code of Marketing of Breast milk Substitutes (International Code); adoption of protective maternity legislation; and implementation of the 'Baby-Friendly Hospital Initiative' (BFHI) to ensure that all hospitals and maternity facilities become centres of breastfeeding support, including the refusal to accept, distribute or promote free or low-cost breast milk substitutes. Governments are also obliged, under Article 24 of the Convention on the Rights of the Child, to ensure that all sectors of society know about the benefits of breastfeeding (8).

In1981 the Sudan participated in the international conference on marketing of breast milk substitutes. A technical committee was established headed by the Nutrition unit/Federal Ministry of Health. The main function was to control and prohibit any violation regarding the importation of breast milk substitute and to discourage the promotion of baby formula in the mass media (9).

In 1992 clear-cut policies regarding the promotion of breastfeeding was introduced under the activity of Baby Friendly Hospital initiative. So the national committee was re-formulated to include paediatricians, obstetricians and mother and

child health professionals. This committee was committed to the initiative. At the end of 2000 thirty hospitals were certified as baby friendly hospitals. Accordingly, the Sudan had adopted the declaration of exclusive breastfeeding for four-six months for ten years. Nevertheless; exclusive breastfeeding for less than four months was 17% only while breastfeeding with plain water was 41%[9]. UNICEF statistics showed that exclusive breastfeeding for six months is only 1% in the Sudan (10).

During the 1990s, modest improvements were made worldwide in exclusive breastfeeding for the first four months of life, with rates increasing from 48 to 52% in the developing world (based on 37 countries with trend data). Timely complementary feeding (at 6 to 9 months) has also improved with levels increasing from 43% to 49%. The proportion of infants still breastfeeding at one and two years of age increased only slightly (10).

1.7.2 Current Literature

In view of the continuing debate, in early 2000, WHO commissioned a systematic review of the published scientific literature on the optimal duration of exclusive breastfeeding; more than 3000 references were identified for independent review and evaluation. The outcome of this process was subjected to a global peer review, after which all findings were submitted for technical scrutiny during an expert consultation (Geneva, 28 to 30 March 2001)

The systematic review summarized studies comparing exclusive breastfeeding for 4-6 months, versus 6 months in terms of growth, iron stores status, morbidity, a topic disease, motor development, postpartum weight loss and amenorrhea. The review was based on two controlled trials and 17 observational studies.

The studies were stratified into three groups: 1) controlled trials 2) observational studies from developing countries 3) observational studies from developed countries.

1.7.3. Controlled Trials

The two trials were from Honduras. The first one was conducted by Cohen in 1994. The total number of participants were141 infants, 50 infants were exclusively breastfed for six months (study group) and 91 were exclusively breastfed for four months then food was introduced (control group). The outcomes assessed were weight, length, haemoglobin, days with fever, cough, nasal congestion and diarrhoea, and the milestones at the age of six months (1). The second trial was carried out by Dewey in 1999. The infants, participating in the study, were 119 babies. Those were divided into two groups, a study group of 59 infants and a control group of 60 infants. The outcomes studied were similar to those in the first trial. The pooled results of both trials showed that there was no significant difference in growth indicators between infants exclusively breastfed for six months and those breastfed exclusively for four months (1). These trials had insufficient statistical power to detect any advantage of exclusive breastfeeding for six months because hygienically prepared complementary foods were used for infants. So there remains the risk of under nutrition with exclusive breastfeeding for six months using locally made foods. With respect to iron status, the trials suggested that, at least in the developing countries where women iron status could be suboptimal exclusive breastfeeding for six months without supplementation may compromise haemoglobin in these infants (1).

1.7.4. Observational Studies from Developing Countries

The observational studies from developing countries were five, four cohort studies and one cross sectional study. The cohort studies were conducted by Brown

1991 in Peru, Adair 1993 in Philippine, Huffman 1987 in Bangladesh and Simondon 1997 in Senegal (4). The cross sectional study was carried out in Chile by Castillo 1996 (4). All these studies assessed growth of infants exclusively breastfed for six months compared to four months and some maternal factors. The results were insufficient to exclude growth faltering with exclusive breastfeeding for six months. But these risks should be weighed against the benefits of reduction in morbidity, especially diarrhoeal diseases. However the results of these studies could not exclude the risk of iron deficiency in susceptible infants

1.7.5. Observational Studies from Developed Countries

The observational studies from developed countries were ten and all were prospective cohort studies. The studies which were conducted by Akeson in Sweden 1996, Heinig in USA 1993 and Kramer in Belarus 2000 assessed growth, infections and chronic conditions (4). These studies agreed that exclusive breastfeeding for six months did not slow down growth at the same time reduced the episodes of infections and other illnesses.

A study conducted by Pisacane 1995 in Italy assessed haemoglobin and serum ferritin (4). It was found that there was no significant difference in haemoglobin level between those exclusively breastfed for six months and those exclusively breastfed to four months and given supplementary food thereafter. Other studies carried by the WHO using a pooled sample of healthy infants from developed countries gave similar results as above.

1.7.6. Geneva Declaration Act/ March 2001

- The expert Consultation committee recommended exclusive breastfeeding for 6 months, with introduction of complementary foods and continued breastfeeding

thereafter. It also stated that the proportion of infants exclusively breastfed for six months can be maximized if these potential problems are addressed:

1. The nutritional status of pregnant and lactating mothers.
2. Micronutrient status of infants living in areas with high prevalence of deficiencies such as iron, iodine, zinc, and vitamin A.
3. The routine primary health care of individual infants, including assessment of growth and of clinical signs of micronutrient deficiencies

- The Expert Consultation Committee recognized the need for complementary feeding at six months of age and recommended the introduction of nutritionally adequate, safe and appropriate complementary foods, in conjunction with continued breastfeeding.
- The Expert Consultation Committee declared that exclusive breastfeeding to 6 months was still infrequent. However, it also notified that there have been substantial increases over time in several countries, particularly where lactation support was available. A prerequisite to the implementation of these recommendations is the provision of adequate social and nutritional support to lactating women.
- The Expert Consultation Committee recommended the following priority research areas which are still under continuous debate:

  The comparison of exclusive breastfeeding for six months and partial breastfeeding for 4-6 months on the following outcomes:

  1. Proportion with growth faltering and malnutrition at six and twelve months
  2. Micronutrient status,
  3. Diarrhea morbidity,
  4. Neuromotor development.

- The assessment of breast milk production and composition of mothers with body mass index<18.5, and the adequacy of breast milk production in meeting infants requirements for six months.
- The identification of the biological and social constraints to exclusive breastfeeding for six months in different geographical and cultural settings, and the development of appropriate and effective interventions to deal with these barriers and their consequences.
- The use of the available opportunities to gain greater insight into the impact of exclusive breastfeeding for six months on mortality.
- The development and evaluation of interventions, for micronutrients supplementation and for complementary foods introduction, in different areas of the world. This would include formative studies to identify processing and preparation methods, and local ingredients required to prepare nutritionally adequate, safe and appropriate complementary foods.
- The detection of the effect of antenatal care during pregnancy on the adequacy of lactation in the first six months (11).

1.8. Global Review

1.8.1. In the Sudan

In the context of global strategy on infant and child feeding, the Sudan revised and adopted its own policy during a national workshop on 22/7/2002/Khartoum. The participants were legal personnel at MOH, senior and junior paediatricians, obstetricians, community physicians, nutritionists, professionals from universities, ministry of labour, women unions, national and international NGOs, WHO, UNFPA and UNICEF. The participants adopted and declared that exclusive breastfeeding should be extended up to six months from birth instead of up to four months, except

in certain circumstances determined by doctors, and that introduction of complementary feeding should be near to the end of six months of age and to continue breastfeeding up to two years and beyond (9). According to the National Nutrition Directorate the mean duration of exclusive breastfeeding in the Sudan was two months and exclusive breastfeeding with plain water was five months.

1.8.2. In Asia

So many researches were conducted after the declaration of exclusive breastfeeding for six months in Asia. On May 2001researchers from Johns Hopkins University School of Hygiene and Public Health in Baltimore studied infants born in Dhaka City, the capitol of the People's Republic of Bangladesh, and found that breastfed infants grew faster than did infants who were only partially breastfed or not breastfed at all (12). The researchers found, however, that exclusively breastfed infants weighed one-quarter pound more and grew one-quarter inch longer than the infants who were partially breastfed or not breastfed at all. The researchers' ultimate conclusion was that food other than breast milk is not necessary - and may be detrimental before six months of age in countries such as Bangladesh (12). This contradicts a study carried out in Bangladesh, India and Nepal by Population and Health Studies, East- West Centre, Honolulu which indicated that supplemented or nonexclusive breastfeeding is more beneficial than exclusive breastfeeding in promoting child survival even for infants under six months of age, suggesting that the WHO and UNICEF guidelines about exclusive breastfeeding may not be appropriate for poor regions in developing countries (13).

1.8.3. In Middle East

In spite of notable achievements by countries like Syria and Egypt having reached more than fifty percent of exclusive breastfeeding at their national levels, the

Middle East and North Africa region has yet to engage in more resolute action to ensure that infants are breastfed between 0-6 months of age. Exclusive breastfeeding rates increased by 10% over the past decade in the region and improvements were also noted in complementary feeding and in continued breastfeeding for the second year of life (7). However, the lack of continued support and irregular monitoring of the process have led to a recent decline in breastfeeding practice. Today, less than half of the mothers in the region are exclusively breastfeeding their infants for up to three months only. This was reported by UNICEF in August 2005. In addition, the poor nutrition and health status of women and female children in lowest-income countries like Djibouti, Yemen, Sudan (and now Iraq) create an inter-generational vicious circle affecting the nutritional status of newborns at a very early stage. As a result, inappropriate complementary feeding and weaning practices are major causes of child under nutrition. Mixed breastfeeding and bottle feeding, and the premature introduction of food are commonly found in all countries of the region (7).

In this region there are varied socioeconomic contrasts. Despite breastfeeding's numerous recognized advantages over artificial feeding, several high-income countries in the region (Bahrain, Kuwait, Qatar, Oman, UAE and Saudi Arabia) maintain patterns similar as European industrialized countries, where exclusive breastfeeding is still below 35% (12% in Qatar and Kuwait ,31% in Oman, 31% in Saudi Arabia and 34% in Bahrain and the UAE) (7).

1.8.4. In Africa

Key nutrition facts in Ghana presented by Ghana Sustainable Change Project (GSCP) indicate that about half of women practice exclusive breastfeeding for six months. The studies therefore noted that the level of sub-optimal feeding, which causes deaths in children, was too high and must be tackled. Sub-optimal feeding is

the failure to do exclusive breastfeeding for the first six months of the baby's life and failure to continue breastfeeding for two years and beyond whilst giving appropriate complementary foods. According to the studies, the effects of this coupled with vitamin A and iodine deficiencies are reasons for the unacceptable rates of stunted growth and anaemia among children in Ghana (14).

In sub- Saharan Africa, only 33% of children under the age of three months are exclusively breastfed due to peer pressure, medical advice and economic considerations, at the same time, the HIV pandemic poses specific challenges to the promotion of breastfeeding (15).

1.8.5. Latin America

In general the greatest improvements in exclusive breastfeeding worldwide occurred in Latin America and the Caribbean. Many researches have been conducted in the last decade. Thus the region ranks high on all indicators of breastfeeding (10).

1.8.6. Europe and North America

Many studies were conducted during the last ten years about the duration of exclusive breastfeeding and its effect on growth, infection, chronic illnesses, development, the IQ of children and some maternal factors. One of these studies was carried out in three nations Sweden, Norway and in the United States (16). The study was conducted by the National Institute of Child Health and Human Development and the Norwegian University of Science and Technology. The researchers chose Sweden and Norway because mothers there exclusively breastfeed their infants for loner duration than mothers in the United States. This study provides strong evidence that exclusive breastfeeding for six months did not compromise growth (16).

2. METHODS AND MATERIALS

2.1. The Study Area

This study was conducted in The Khartoum State which is the largest state in Sudan in terms of the size of the population. The inhabitants come from all parts of the country. The Khartoum state is about 28165 square kilometres in area and has a population of more than 5 million persons. Khartoum is divided into three main towns: Omdurman, Khartoum and Khartoum north. These towns are subdivided into municipalities. Omdurman is subdivided into three municipalities: Ombuda, Omdurman and Karari. Khartoum North is subdivided into two municipalities; Bahri and East Nile. Khartoum town is subdivided into two municipalities; Khartoum and Jabal Awlia. Each municipality has several health facilities ranging from hospitals to health units.

Omdurman Maternity Hospital (OMH) is the largest specialized maternity hospital in Khartoum and receives thousands of patients each month from all parts of the State of Khartoum and other states according to the hospital records. For this reason, this facility was chosen and the study sample was selected among the babies who were born there. Only one facility was chosen rather than many, to minimize the cost and effort of selecting the sample.

2.2. The Study Population

All healthy infants who were born during the period 2nd of April to 2nd of May 2005 were offered the chance to participate in the clinical trial. The idea was reviewed with the mothers and different aspects of the study were explained. Three medical officers, a sister and two nurses were involved in the selection of the infants by carrying

medical examinations, taking measurements and filling the cards for the candidate participants. A blood sample was taken from each infant for assessment of Hb concentration. The blood sample was taken in EDTA tube and all samples were investigated at one clinical laboratory which was taken as a reference lab.

2.2.1. The Target Population;

A mother with live birth born at Omdurman Maternity Hospital during 2-April to 2-May whose infant fulfilled the following inclusion and exclusion criteria:

The inclusion criteria

- Infants whose families reside within Khartoum state.
- Infants who weighed at least 2.5 kg at birth.
- Full term infants.
- Infants with haemoglobin concentration 14g/dl or more.
- Infants whose mothers agreed to breastfeed them exclusively for the desired period.

The exclusion criteria

- Infants with congenital malformations.
- Infants with birth traumas.
- Preterm infants.
- Infants with asphyxia.
- Low birth-weight infants.
- Infants whose mothers violated the instructions at a later stage would be excluded. (Drop rate expected about 25%).
- Infants who developed non nutritional anaemia during the study period.

2.2.2 Eligible Population:

This group consisted of infants fulfilling the inclusion criteria and whose parents agreed voluntarily to exclusively breastfeed their infants for the period determined by the study. At the age of four months they were divided randomly into two main groups:

- The first or reference group was allowed to introduce supplementary food after exclusively breastfeeding their infants for four months (group A)
- The other group, or the study group, continued to exclusively breastfeed their infants up to the age of six months (group B).

Group A: This group was allowed to give supplementary food and continue breastfeeding. The investigator did not provide any food to the families. The mothers were free to choose the type of food for their infants.

Group B: This group was then subdivided randomly into two subgroups:

Group BFe: This group of infants was given an iron supplement for two months. Each infant was given 2ml/day of ferrous sulphate syrup.

Group BPb: This group was given a placebo for two months.

2.3 Sampling Frame

- All the neonates, who were born at OMH during the period from 2/4 to 2/5, were considered eligible for the study.
- The live births, whose parents agreed to participate, were potential participants.
- The healthy infants who fulfilled the criteria and their mothers agreed to participate were the participants.

2.4 The Statistical Determination of the Sample Size:

The following mathematical equation is used to determine the ideal sample size for a study based on a clinical trial (17). The sample size n for each group is:

$$n = \frac{Z_{\alpha}\sqrt{2\pi_C(1-\pi_C)} - Z_{\beta}\sqrt{\pi_t(1-\pi_t)+\pi_C(1-\pi_C)}}{\pi_C - \pi_t}$$

Where:

Z_{α} = α error of 5% = 1.96

Z_{β} = β error of 20 % = 0.84

π_t = proportion EBF for six months = 5 %

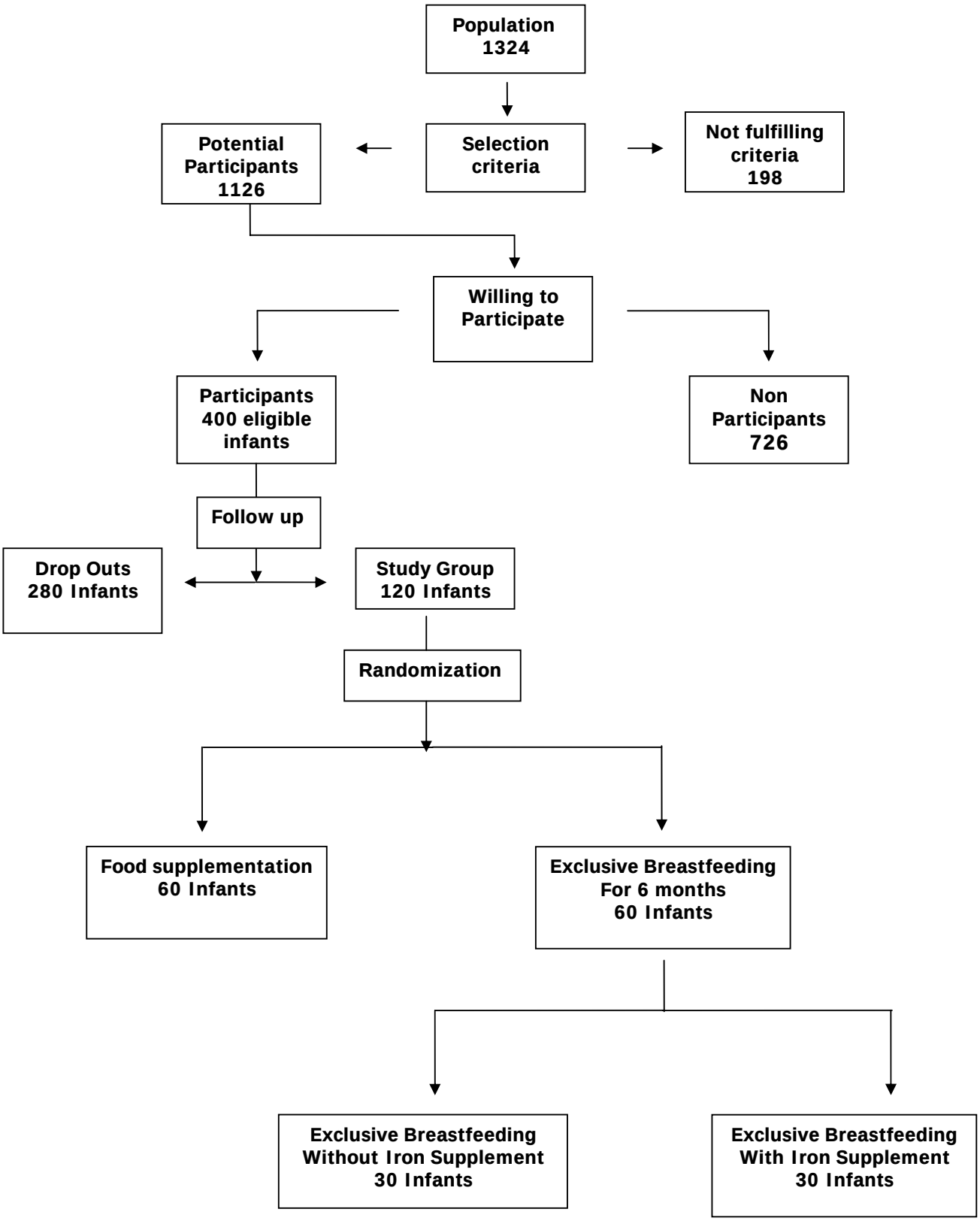
π_C = proportion EBF for four months = 20%

n = 98

Drop out rate = 25% of the sample size.

Each group = (98 * 125)/100 = 123

2.5 Representation and Recruitment of the Participants



2.6 The Study Design

This investigation is a facility and community based study. The study is a randomised and blinded clinical trial, following infants and mothers for six months. The infants were selected from a Maternity Hospital starting from the delivery room. The follow up was carried at their homes and at the nearest health facility to their homes. The following study variables were taken into consideration:

1. Age
2. Weight
3. Length
4. Hb concentration
5. Socio-economic factors:
   a) Mother's education
   b) Family expenditure
   c) Family size
   d) Supplementary food, quantity and quality.

During the first month of the study, 400 mothers, whose infants were eligible, agreed to participate. The selection process, which was expected to be completed in seven days, continued for thirty days because most of the infant's families were not willing to participate. The selected mothers provided their addresses and telephone numbers to be followed up at their homes. For each participant two cards were filled with the name, address, telephone number of the parents, and the weight and length of the infant. The two cards have the same serial number. One of the cards was given to the investigator and the other was left with the mother to be followed at home. A tag containing the name was tied around the infant's wrist for identification in the community or at home.

Twelve dietician' assistants were assigned to contact the mothers at the community level, in order to first locate the house, and then determine the nearest health centre to their home, and fill a new card for follow up. Most of the participants were from Omdurman area, but some were from Khartoum and Khartoum North areas.

There were 346 infants out of 400 infants residing in Omdurman area, which is 86.5% of the total number. While there were 41 infants residing in Khartoum North area, which is 10.25% of the total number. From Khartoum area there were only 13 infants, which is 3.25% of the total number.

The first visit for each infant was done within one month of birth. The dietician' assistants faced many problems which could be summarised into:

- Wrong addresses
- Wrong or disconnected telephone numbers.
- False information.

In addition to that, some of the participants were excluded for other reasons, mainly the non compliance of the parents to exclusive breastfeeding and the death of some participating infants by septicaemia and malaria.

Accordingly, after two months from the starting day, the results of the visits were as follows:

- There were 98 infants that could not be reached by the dieticians. That is 24.5% of the total number.
- There were 73 infants whose parents did not comply with the regime. This is 18.25% of the total number of eligible infants.
- There were 35 infants who were excluded because of failure of criteria. This is 8.75% of the total number.

- The infants who died during this period were 4 infants. This is about 1.0% of the total number.

So there were 210 infants lost from the study during the first two months. This is 52.5% of the total number of infants. While there were 190 infants whose parents agreed to continue to participate. This is about 47.5% of the total eligible infants.

The participants were given new cards with a table for weights, lengths and Hb concentration on one side and a table for recording types and quantities of food given to the infant on the other side. These cards had the same serial numbers as the cards issued in the hospital.

At the age of four months there were 120 infants committed to the study and that is 30% of the original group. There were 70 infants who were lost during the second period of two months. From these, 64 infants were lost due to non-compliance that is 16% of the eligible infants. While there were 4 infants that left to other regions outside greater Khartoum and two infants died during this period. This is about 1.5% of the total number of infants.

The Situation after completion of four months:

So at the age of four months, the following numbers of infants were continuing with the study:

- In Group (A), the group which was going to introduce food, only 60 infants remained.
- In Group (B), the group which continued exclusive breastfeeding for six months, 60 infants remained. This last group was subdivided into two equal sub-groups for the introduction of the iron supplement (BFe) and the placebo (BPb):
    - Group (BPb) had 30 infants, while

- Group (BFe) had 30 infants

The Situation after completion of six months:

- The number of infants in group (A), whose data and information were going to be analysed, dropped to 57 infants.
- The number of infants in group (B), whose data and information was completed and ready for analysis, was 59 infants.
  - Group (BPb) had 30infants, while
  - Group (BFe) had 29 infants.

2.7. Interventions:

2.7.1. Tools, Materials and Facilities for Intervention

The following tools, equipment and materials were provided to the field workers and the mothers to help them in carrying out the required measurements:

1. Salter scales were used for measuring the weights of infants. Salters were standardised in all centres.

Fig2.1: Salter scale

2. A cup, a dish and a spoon were issued to each mother in Group (A) to enable her to measure the amount of supplementary food given after four months of age.

Fig 2.2: Cup, dish and spoon

3. Special measuring sheets were used to measure the lengths of infants.

Fig2.3: Measuring sheet

4. Syringes were used to take blood samples
5. EDTA tubes were used to collect the blood samples, which were subsequently analysed using a spectrometer.
6. Name tags were used at birth to identify the infants in the community.
7. Serially numbered identification cards with the names of the fathers, the mother and the infant were issued to the parents.
8. Identification cards with the same serial numbers were kept by the investigator. These cards contained the same information and measured data about the infants, together with detailed addresses, telephone numbers and the nearest health facilities to the infant's home.
9. Duplicate follow-up cards, with the same serial numbers, were used for monitoring growth and recording the types and amounts of food introduced to the infants after four months.
10. A constructed close-ended questionnaire was used to collect information about the participating families and the factors affecting exclusive breastfeeding (Annex 1).

11. There were eight health facilities for the medical care of the infants and their families.
12. Fifty-three health centres in the three towns of the State of Khartoum were selected for follow up of the participating infants (Annex 2).
13. Ten health centres were equipped to do the measurements at the age of four months and at the age of six months (Annex 3).

2.7 .2 Techniques and Procedures Used during the Interventions

a) Techniques of Intervention

The intervention in this study was conducted in two occasions. The first intervention was at birth. At this age the mothers were instructed to exclusively breastfeed their infants and that only breast milk should be given, no water, juices, semi-solid or solid food were allowed.

The second intervention was carried at the age of four months. At this age the participating infants, who were divided randomly by a statistician into two groups A and B, had certain technique of interventions.

The Intervention in Group A:

The mothers of the infants of this group were allowed to introduce food to their infants at the age of four months. No specifications of food were given for these mothers and they were free to use the available food at their homes. The study did not intervene in the nutrition of the infants or the mothers and so no food or money was given to them. In order to identify the quality and quantity of the supplementary food which was given, certain measures were used:

1. The families were given dishes, cups and spoons as tools to determine the amount of food and fluids given to the infants

2. The amount of food was recorded by the dietician assistants during their home visits to the families in group (A)
3. The food information was recorded about the day preceding the visit from morning to night of that day.
4. Food information was recorded for four different days at ages of 4.5,5, 5.5 and 6 months.

The Intervention in Group B

The infants of Group B at the age of four months were subdivided into two subgroups designated Group Bfe and Group Bpb.

The mothers of Group Bfe were instructed to continue exclusive breastfeeding to the age of six months. They were supplied with an iron supplement (ferrous sulphate syrup) for their infants. The mothers were instructed to give the infant 2mls of the syrup every day for two months. The concentration of ferrous sulphate was (60mgs/5mls).

The mothers of Group Bpb were instructed to continue exclusive breastfeeding to the age of six months and they were given placebo syrup. This syrup was made by Sigma Tau Pharmaceutical Company especially for this study. The bottles of the placebo syrup were similar in size to the bottles of the ferrous sulphate syrup. The mothers were instructed to give the infants 2mls of the syrup every day for two months.

b) The Procedures Used during the Intervention

Monitoring of Growth

This was done by monitoring weight and length for six months starting from the delivery room.

Monitoring of Weight

This was done by weighing the infants every two weeks using the Salter Scales. The measurements were conducted in the neighbourhood health facility. The Salter Scales were standardised in all centres. The dietician assistants were trained to use these weighing tools. The infants at the age of four and six months were weighed in specific centres by highly trained dietician assistants to the nearest 50 grams. All measurements were recorded in the mothers' cards and the investigator's cards

Monitoring of Length

This was carried out by measuring the lengths of the infants at birth, four months and six months. The measurements were done at the nearby health facility. The lengths were measured using special measuring sheets. The measurements were carried out by the dietician assistants to the nearest 0.5 centimetre, and were recorded in the mothers' cards and the investigator's cards.

Monitoring of Haemoglobin

Haemoglobin concentrations of all infants were assessed at birth, and at the ages of four months and six months. The blood samples were taken by lab technicians at the specified health centres, and taken to the reference lab in EDTA tubes. The samples were examined within twelve hours of collection.

Measurement of Haemoglobin Concentration by Spectrometer Using the Hb-Cyanide Method (18):

This is the World Health Organization's recommended method for determining the haemoglobin concentration of blood. The basis of the method is the dilution of blood in a solution containing potassium cyanide and potassium ferricyanide. Haemoglobin, methaemoglobin and carboxyhaemoglobin are converted to cyanmethaemoglobin.

The absorbance of the solution is then measured in a spectrometer at a wavelength of 540 nm or a photoelectric colorimeter with a yellow-green filter.

This method has the advantage over all other methods of having stable and reliable reference preparation. The Hb of the diluted blood sample can be determined accurately by spectrometry. The blood is diluted 1: 201 (or 1:251) with cyanide-ferricyanide reagent and the absorbance is measured at 540 nm.

The procedure consists of adding 20 μL of blood to 4 ml of diluent making a dilution of 1 in 201. The tube containing the solution is closed and inverted several times. The tube is allowed to stand at room temperature for at least 5 minutes to ensure conversion of all Hb to haemiglobinocyanide. The sample is poured in a cuvette and the absorbance is read by the spectrometer at 540 nm. The absorbance must be read within 6 hours of the sample preparation.

Calculation**:**

$$\text{Hb(g/l)} = \frac{A^{540}\text{ of test sample}}{A^{540}\text{ of standard}} \times \text{conc. of standard} \times \frac{\text{Dilution factor(201)}}{1000}$$

2.7.3 Ethical Consideration

The parents' consents were taken at the delivery room. The medical officers explained to the parents all the steps and procedures of the study during the six months.

The parents had the right to stop participating any time during the study.

The parent had the right to know all the information regarding their infant's health and growth.

2.7.4 Data collection

a) Infants Records

Especially designed cards with serial numbers were filled for these infants. The cards had two parts. One part was filled with the infant's information, full address of the family and their phone numbers. This part was kept by the investigator. The other part, with the same serial number, consisted of the infant name, the mother's name and the investigator's name. This part was left with the mother for identification in the community (Annex 4). These cards were essential for the study programme as they were the only means to reach these families. The medical officers and their assistances ensured that each participating infant had his weight, height and date of birth recorded in the card before leaving the hospital. For this reason, they continued to work daily for the whole month. The medical officers and the paramedical staffs were working in shifts (Annex 5). By the end of the month, four hundred infants were selected.

b) Assessment of Hb concentration

A blood sample was collected from every participant for assessing Hb concentration by the appointed nurses who were adequately trained to take the blood samples from the neonates. The blood samples were kept in a refrigerator until they were sent to the

laboratory. They were picked up at 8am and at 8 pm everyday by an appointed doctor and taken to the reference laboratory. The Hb assessment was carried out at birth in the hospital and later at the ages of four and six months for every infant.

c) Identification of Infants' Homes

A new team, which consisted of thirteen dieticians and dietician assistants, was recruited to reach those neonates at their homes. (Annex 5).

Their duties and responsibilities were:

1. To locate the neonates' homes using the information in the cards.
2. To ensure the approval of the families to continue with study and their compliance with the directives.
3. To locate the nearest health centre or the preferred one for follow up.
4. To fill a new follow up card for the complying infants.

From the basic information collected, it was found that the infants were scattered in the three towns but the majority were in Omdurman town. A tremendous effort was done to reach them because most of the streets, side roads and houses had no numbers or letters for identification. Knowing this fact, it was decided that the team of dieticians should have mobile phones and be provided with a means of transportation or funds to use the available means in order to locate those infants' homes. In spite of all these measures, the process of locating those infants was difficult. Using the phone numbers which were recorded in the cards did not help in many cases because of the problem of wrong numbers; disconnected numbers and that some of the families live in squatter settlements with no telephone services.

In order to solve these problems the team decided to take certain steps:-

1. Ask the assistance of the people's committees of the administrative unit.
2. Look for help from the Sheik or Umda of the area or village.

3. Seek the help from the telephone company for the disconnected phone numbers by temporarily reconnecting the line.

In the first 6 weeks of the study 302 infants were reached (75.5%), while 98 infants were not reached because of the above problems or because their parents declined participation by giving wrong addresses and phone numbers. The infants who were reached were classified into groups according to their conditions in the following manner:-

1. Complying group: and this included 190 infants (47.5%).
2. Non-complying group: that included 73 infants (18.25%),
3. Failure of criteria group: that included 35 infants (8.75%).
4. Deaths: that included the remaining 4 infants (1%).

The percentage of the infants who were lost due to non compliance or failure of selection criteria or death constituted about 52.5% of the total infants selected. Failure of criteria was mainly due to wrong information which was given by the parents regarding their residency in greater Khartoum area.

The complying infants at two months of age were 47.5% of the selected infants. Those infants were provided with new follow up cards. These cards were especially designed for recording the follow up data and were given a different colour from the previous identification cards (Annex 6).

d) The Follow up Technique

Recruiting the Staff

The complying infants were provided with the follow up cards which had the same serial numbers as the previous identification cards. Those infants were going to be followed up in the state health centres and hospitals. Special permissions were

obtained from the State Ministry of Health and the municipality health offices in order to allow the investigator to use these centres.

The health centers were chosen according to proximity to the infants' homes. Fifty three health centers were selected for the follow up process. The nutrition officer of each municipality contacted the dietician assistants in the selected health centers, and briefed them about the study scheme and the participants were appointed immediately. The infants were assigned to each of these health centers according to the geographic area and the preference of the family. Each dietician assistant selected the number of infants that she could follow, and was paid accordingly. The health centers were provided with backup record cards carrying the same serial identification numbers as those with the families, and these cards were kept at the centers. The nutrition officer drew a programme of home and health center visits for each infant and was passed to the dietician to implement.

The nutrition officers held a monthly meeting with the dietician assistants who were employed in the programme for reviewing the collected data and solving any problems they encountered (Annex 5). At the end of every month, the officers submitted reports to the investigator about the progress of the infants, the problems that needed solutions and the disbursement of the funds.

Implementation of the Follow-up Plan

The investigator and the supervising officers agreed that each infant had to have two visits to the health center every month and should be visited (surprise visits) twice every month at home. The assistants were given incentives for every visit and paid for transport and phone calls. All health centers which were involved were equipped with Salter scales, measuring sheets, EDTA tubes, ferrous sulphate syrup, placebo syrup and some medicines that were donated to the study programme.

An emergency phone number, which was available day and night for medical help and advice, was provided to the families. The families were also offered free medical care for the whole family in the nearby health centers. This close medical care was offered so as to control infections in the families. The control of infections was important to prevent confounding of growth of these infants. In order to provide this service, the investigator obtained the permission from the health authority to establish weekly clinics in eight health centers and hospitals. These clinics strengthened the relationship with the families and ensured the compliance of the mothers. The compliance was tested during the home visits by looking for signs of use of supplementary food. The dietician assistants looked for feeding bottles, herbal tea or any other sweetened solutions. They also questioned the family members about the condition of the infants and how they were caring for them. All infants who had diarrhea were investigated socially and clinically to verify whether it was due to supplementary food.

The compliance of these families was at times challenged by other medical doctors who were visited by the participating parents for treatment or otherwise. They gave contradicting information and orders and some times even prescribed formula milk. Some paramedical staff in the centers and the community also shared the responsibility with some doctors in misleading those mothers. In addition to this, the community around the mothers was not accepting the idea and so the mothers were put under severe pressure to quit. The result of all this intervention was non-compliance of more infants' mothers. Seventy more of the enrolled infants were lost before the age of four months. Sixty four of them were lost due to non compliance, while four more were lost because their families moved out of the state and two died.

Collection of data at Four Months

The dietician assistances brought the infants for weight and height measurement and Hb concentration assessment when the infant completed four months of age. The measurements were taken within forty eight hours from the designated date. On that day, the mothers were told about the plan for the infant for the coming two months. Mothers of group A were instructed to start complementary feeding for their infants. They were given graded cups, small dishes and spoons to use for feeding their infants. These utensils were given to help the dietician to assess the quantity of food given each time. The type and quantity of food were recorded in the follow up card in four different fortnightly visits. In each visit the dietician enquired about what was given to the infant on the previous day.

The weight and height were measured at the health centers as planned but assessing the Hb concentration was faced by some difficulties. The lab technicians in some health centers failed to take the blood samples from the infants, so the help of a doctor was needed. A doctor was recruited to be on call whenever he was needed. Also some of the families refused completely the idea of taking blood samples from their infants, although they agreed at the beginning. Thus the number of infants who had their Hb assessed was less than the total number of infants participating in the study. The blood samples were collected every day from these centers and brought to the reference lab for assessment of Hb concentration.

The data which was collected at the age of four months were presented to the officers for review and approval before it was submitted to the investigator for analysis.

The questionnaire was distributed to the health centers at this stage, it was a close ended questionnaire constructed in an easy way for the dietician assistances to fill on

behalf of the families during the home visits. 116 copies of the questionnaire were distributed, of which 103 (89%) were answered and returned back to the investigator.

Collection of Data at Six Months

At the age of six the same procedures of work were followed. All the infants were brought to the health centers for measurements. All Hb concentration assessment was done in the reference lab. The collected data was revised by the officers, approved and then submitted to the investigator for analysis.

For the infants in group A the types of food introduced were identified and their quantities were determined in grams. There were twenty nine items of food used by those infants (Annex 9).

In December 2005 all the information about this study was collected and computerized and ready for analysis.

2.7.5 Processing and Analysis of Collected Data

The variables for comparison were:

- Weight for age
- Length for age
- Weight for length
- Haemoglobin concentration

1. The nutrition status of the infants was determined in the two groups at birth and at the age of four months using the Z- score.
2. For comparison of Group A and Group B in terms of weight or height or haemoglobin concentration t- test for comparison of means was used.

3. The mean of the weight-age Z-scores at six months for each group was determined and compared to detect the presence of a difference between the two groups.

4. The mean of the length-age Z-scores at the age of six months for Group A and Group B were calculated and compared.
5. The mean of the weight- length Z-scores at the age of six months for the two groups A and B were determined and compared to elicit any significant difference.
6. < -2 Z-score was selected as the cut off point for assessing malnutrition in the groups. The risk of having less than -2 Z- score in weight-age, length-age or weight-length because of the type of feeding, was determined using the Chi^2 test and the Relative Ratio.
7. The mean Hb concentration was assessed for Group A and Group B at birth and at the age of four months. The two groups were compared with the normal reference value to identify the Hb concentration status of the infants at birth and four months of age.
8. The Hb concentration was calculated for Group A, Group BFe and Group BPb. The three groups were compared with each other using the t-test for multiple comparisons and ANOVA.
9. The incidence of infants having Hb concentration of less than 100gm/l (WHO cut off point for anaemia) were determined. Chi square-test was used to determine the relationship of anaemia with the type of feeding. The Risk Ratio for being exposed to anaemia was calculated.

2.7.6 Processing and Analyzing Data of Socioeconomic Factors

The growth of infants is affected by the feeding practices of their mothers, but there are other factors which would affect the growth of infants. The socioeconomic factors have great impact on growth. The main factors which could have affected the results of this clinical trial were as follows:

- ✓ Education of mothers
- ✓ Expenditure of the family
- ✓ Size of the family
- ✓ Quality and quantity of food supplementation

A close ended questionnaire was constructed to collect the data from the participating families so as to study the socioeconomic factors (Annex1). The questionnaire consists of two sections. The first section is concerning the mother while the second section is about the family expenditure and the home environment. The questionnaires were filled by trained dietician assistants at the age of four months during the home visits.

The number of the study group expected to answer the questionnaire was 116

The percentage of answered questionnaires was 90% (103).

In analyzing the socioeconomic factors the weight and Hb concentration had been used as the dependant variables while the factor under study was used as the independent variable.

1. The effect of the mothers' education on infants' growth was determined using the mean of the weights and the mean of Z-scores for weight-age for comparison.
2. The effect of families' expenditure on infants' growth was determined using the mean of the weights and the mean of Z-scores for weight-age for comparison.

3. The impact of the family size on the growth of infants was assessed using the mean of the weights and the mean of the Z-scores for the weight-age for comparison.
4. Food quantities consumed by infants' were analyzed to their basic nutrients by using the Sudanese food tables (Annex 7). The basic nutrients, in which the study was interested, were proteins, carbohydrates, fats, energy and iron content.
5. The mean value of each nutrient consumed by every infant was determined.
6. The effects of the education of the mothers, the family expenditure and the family size on the Hb concentration were studied using the mean Hb concentration of the infants for comparison.

3. RESULTS

3.1 Evolution of the Study Group:

The number of new born infants who were initially selected after birth at the Omdurman Maternity Hospital was 400. The selection was in accordance with the criteria outlined in Chapter 2. During the subsequent follow-up at the community level, only 302 or about 75% were available. The homes of the remaining families could not be located from the information which they provided in the hospital. During the course of the study, some of the families declined to stick to the study rules and started to introduce food supplements to the babies, and were immediately excluded from the study group. Of the 302 infants who were initially enrolled, only 116 or about 38% continued to abide by the rules of the study for the whole period.

For every member in the study group, three parameters were measured and tested to assess his nutritional status at birth, at the age of four months and at the age of six months. These parameters were weight, length and Hb concentration. The data for these measurements are listed in (Annex 8) for Group A and (Annex 9) for Group B.

3.2 Nutritional Status of the Study Group at Birth:

The Distribution of Infants' Weights:

The mean weight of infants in Group A at birth was 3.43 kg with a standard deviation (sd) of 0.47 kg.

The mean weight of infants in Group B was 3.46 kg with sd of 0.45 kg.

In comparing the two groups using the T-test for equality of means, the p-value was 0.737 and the mean difference was -.028 (95%cl -.19 to .14). This result indicated that the mean weight of Group A and the mean weight of Group B were similar; there was no difference in weight at birth as shown in (Table 1)

However, the mean weights of the two groups were slightly higher than the mean of reference infants' weight as is evident in (Table 2).

The Distribution of Infants' Lengths:

The mean length of infants in Group A was 51.5 cm with sd of 3.4 cm.

While the mean length of infants in Group B was 50.6cm with sd of 2.4cm.

Using the T-test for equality of means, the p-value was 0.140 which was slightly higher in Group A than Group B with a mean difference of 0.81cm (95%CI of the difference -0.27 to 1.9) as seen in (Table 3).

Again there was insignificant difference in length between both Group A and Group B and the reference values of infants' lengths as shown in (Table 4).

The Distribution of Infants' Hb Concentration:

The mean of Hb concentration in Group A was 171 g/l with sd of 18 g/l.

While the mean Hb concentration for Group B was 173g/l with sd of 18 g/l. Again using the T-test for equality of means, the p-value was 0.55 and a mean difference of -.2.0 (95% CI of -8.8 to 4.7), which was an insignificant difference. So there was no difference in Hb concentration between Groups A and B at birth as shown in (Table 5).

The mean Hb concentration of Group A was insignificantly lower than the reference Hb concentration and the p-value was 0.339. Similarly Group B the Hb concentration was lower than the reference value and the p-value was -.316 as shown in (Table 6).

However, the Hb concentration of both Groups A and B were lower than the reference Hb concentration of infants at birth.

3.3 Nutritional Status of Study Group at the Age of Four Months

The second milestone for measuring the nutritional status of the infants was at the age of four months. The condition of the infants at this stage was considered as the baseline for the study because it is the reference status for measuring subsequent changes arising from the differences in the feeding method.

The Distribution of Infants' Weights:

The mean weight of infants in Group A at the age of four months was 6.67 kg with SD of .88 kg. While the mean weight of Group B was 6.60 kg with sd of 1.01 kg.

In comparing the two groups the T-test of equality was used, the p- value was 0.710 and a mean difference of -0.029(95%CI -.26 to .21). So this result indicated that there was no difference in weight between the two groups at this stage as in (Table 7 & 8).

The Distribution of Infants' Lengths:

At the age of four months the mean length of infants in Group A was 64.9 cm with sd of 2.6cm. While the mean length of Group B was 64.4cm with sd of 3.6cm. Using the T-test of equality of means, the p-value was 0.317 and the mean difference of 0.592 (95%CI of diff. -0.592 to 1.757). So there was no difference in length between the two groups in this age as in (Table 9 & 10).

The Distribution of Infants' Hb Concentration:

The mean Hb concentration at the age of four for Group A was 109gm/l with sd of 19gm/l. While the mean Hb concentration for Group B was 109gm/l with sd of 16gm/l. Using the T-test of equality of means the p-value was .95 and the mean difference was .022 (95%CI of the diff -.72to .77). This result was insignificant and showed that there was no difference in Hb concentration between Group A and Group

B as shown in (Table 11). In comparing the results of the two groups with the reference value of Hb concentration at the age of four months the Hb concentration of the two groups dropped to levels slightly lower than the reference value, as shown in (Table 12).

3.4 Nutrition Status of Study Group at the age of six months:

The last milestone in assessing the nutritional status of the study group was at the age of six months. The results at this age reflect the effect of the feeding practice each infant was subjected to. Food was introduced to Group A at the age of four months while they were continuing breastfeeding. Group B continued exclusive breastfeeding to the age of six months, but the group had been subdivided into subgroup BFe which had iron supplement and subgroup BPb which had no iron supplement but had placebo syrup for two months from age four months to age six months. This last subgroup was the group which was truly exclusively breastfed.

The Distribution of Infant' Weights

At the age of six months the mean weight of Group A was 8.37kg with sd of 7.4kg. While the mean weight of Group B was 7.30kg with sd of 1.09kg. This result indicates that the weights in group A were dispersed in a wide range as the sd has a large value (7.4) while group B showed clustering of weights, as the sd value is small (1.09).

In comparing the two groups using the T-test of equality of means the p-value was 0.185 with a mean difference of 1.07(95% CI -.87 to 3.0). This result was insignificant statistically, but the weights were slightly higher in group A than Group B as seen in (Table 13).

The mean of the Z-scores of weight-age for Group A was -.225 with sd 1.529. While the mean Z-scores for Group B was -.331 with sd 1.766. The mean difference was .106 and the p-value was.729 which indicates insignificant difference between the two groups as evident in (Table 14).

The monthly weight gain for Group A (4-6 months) was 351gm/month as in (Table 15). While the monthly weight gain for Group B for the same period was 348gm/month as in (Table 16). Comparing the weight gain of the two groups using the t-test of equality of means the p-value was .95 and the mean difference was 3.0 (95%CI -.10 to .11). The weight gained by the two groups was almost similar as evident in (Table 17).

The incidences of infants having weight-to-age Z-scores less than -2sd were eight infants in Group A and thirteen infants in Group B as shown in (Table 18).

Then the relationship between the duration of exclusive breastfeeding and the weight-age Z-scores less than -2sd was determined using chi square test and the relative ratio.

The chi square test was 0.25 with df of one and the p- value of 0.616 as in shown in (Table 19).

The relative ratio was 1.57 (CI 3.494 to.705).

This result showed that the duration of exclusive breastfeeding for six months had no significant effect on the weights of infants at this age.

The Distribution of Infants' Lengths

The mean length of infants at the age of six months of Group A was 68cm with sd of 2.7cm. While in Group B the mean length was 68.4cm with sd of 4.0cm.

Again using the T- test of equality of means the p-value was 0.571 and the mean difference was -.36 (95%CI of the diff. -1.63 to .90) which was insignificant

statistically. And so there was no difference in length between the two groups as shown in (Table 20).

The mean of the Z-scores of length-age for Group A was 0.99 with sd of 1.3. While the mean of the Z-scores of length-age for Group B was 1.17 with sd of 2.0. The p-value was found to be .57 and the mean difference was -.18 and (95%CI of the difference -.82 to 45).

The mean Z-scores of the two groups show insignificant differences as seen in (Table 21).

The mean length gained by Group A (4-6 months) is found to be 1.5cm/mon with sd of 1.0cm. While the mean length gained by Group B was 2.0cm/mon with sd of 1.99cm. Using the t-test for comparing the two means, the p-value was found to be 0.02 and the mean difference was -.47 (CI -.891 to -.064). The result is statistically significant and shows that there was a difference in length gained. Group B gained more length than Group A as evident in (Table 22).

There were four infants in Group B having length-age Z-scores less than -2.0sd

No infant in Group A had a Z-score less than -2sd as in (Table 23).

The effect of the duration of exclusive breastfeeding on length at six months was analyzed using the chi square test.

The chi squire test gave a value of 4.0 with df of1.0 and the p-value of 0.045 as in (Table 24).

This result showed that the length was influenced by the duration of exclusive breastfeeding; the infants who were exclusively breastfed for six months were shorter than those supplemented by food at four months of age.

The Distribution of Weights- Lengths at the age of six months

The mean of the Z-scores of weight-length for Group A was -4.9 with sd of 9.8.

While the mean of the Z-scores of weight-length for Group B is -7.5 with sd of 8.2.

The p-value was 0.13 and the mean difference was 2.56 (95%CI of the difference -.76 to 5.9) which indicates insignificant difference between the two groups as shown in (Table 25).

Group A had ten infants with Z-scores of weight-length less than -2sd, while Group B has thirteen infants with Z-scores of weight-length less than -2sd as shown in (Table 26).

Chi-square test is used to determine the relationship between the duration of exclusive breastfeeding and low weight-length Z-scores. The chi square value was 0.368 df of 1.0 and p-value of 0.544. (Table 27)

This result showed that there was no relation between the duration of exclusive breastfeeding for six months and low Z-scores of weight-length. The relative ratio of having low weight-length Z-score is 1.226 (95%CI 2.57 to -0.58).

This indicates that exclusive breastfeeding for six months did not expose the infants to have low weight-length compared to exclusive breastfeeding for four months.

Distribution of Infants' Hb Concentration

At the age of six months there were three groups for analyzing Hb concentration data, Group A which had supplementary food, Group Bfe which continued exclusive breastfeeding to six months but received iron supplement and Group Bpb that continued exclusive breastfeeding without supplementation.

The mean Hb concentration of Group A at six months was 106gm/l with sd 16gm/l. For Group Bfe the mean Hb concentration was 104gm/l with sd of 8.0mg/l. While the mean Hb concentration of Group Bpb was 104gm/l with sd of 17gm/l.

Using the T-test of one sample statistics the Hb concentration levels in the three groups were insignificantly lower than the normal values of this age as shown in (Table 28).

For comparing the three groups, the p-value was 0.716 which showed no significant difference between the three groups. Also using multiple comparisons tests the results indicated no significant difference at .05 levels as shown in (Table 29).

The infants who have Hb concentration less than -2sd were detected in the three groups.

The infants in group A who have Hb concentration less than -2.0sd (100gm/l) were fourteen (31.1%), while there were seven infants in Group BPb (36.8%) and six infants in Group BFe (33.3%) as indicated in (Table 30).

Chi-square test was used to determine the relationship of exclusive breastfeeding with iron supplementation and food supplementation.

Chi square was 0.102 with df of 2.0 and p-value of 0.95. (Table 31)

This result indicated that introduction of food did not improve the Hb concentration levels in infants nor did the iron supplement which was given to infants exclusively breastfed to six months of age.

The relative ratio for infants having low Hb concentration in Group BPb to those infants in Group A was 1.18 (95%CI +3.43 to -1.07). The two groups had similar risk to low Hb concentration levels. The relative ratio for infants having Hb concentration less than -2sd in Group BFe to those infants in Group A was 1.072(95%CI 3.23 to – 1.094).

So the infants who were given supplementary food and those who were given iron supplement were having the same risk of low Hb concentration at the age of six months.

The relative ratio for infants having Hb concentration less than -2sd in Group BPb to those infants in Group BFe was 1.105(95%CI 3.338 to -1.128). This result meant that the infants who were exclusively breast fed for six months without any supplementation were at the same risk as those given iron supplement at the age of four months.

These results showed that the infants had low Hb concentration at birth and continued with this through out the period of the experiment. The iron supplement and the food supplementation did not improve the Hb concentration of these infants.

3.5 The Socio-economic Status of the Families

The results which are obtained from this clinical trial cannot be isolated from the environment surrounding these infants, so a brief description of the socio-economic conditions of these families is important. The following statistics were obtained from the questionnaire which was discussed earlier. The family status will be classified through the indicators of residential neighbourhood, water supply and waste water disposal.

The residential class of the study group has been classified into four main classes as shown in (Figure 1).

The water supply to these families had been classified into two types; tap water and water distributed on animal-driven carts, as seen in (Figure 2). Although most of these families use tap water, they rely on storing the water because of the interrupted supply. The modes of storage used are shown in (Figure 3)

Most of the families live in areas with poor sanitation. The type of sewage disposal for these families is described in (Figure 4).

Education of the Mothers' Data

The distribution of the participating mothers according to education level is demonstrated in (Figure 5).

In comparing the education levels of the mothers using the weight as the dependant variable the p-value of the all effect was 0.074 which is insignificant at 0.05 levels but is an important indicator of the impact of the mothers' education on infants as in (Table 32).

The details of the multiple comparisons indicated a significant difference in infants' weights of illiterate mothers when they were compared to infants' weights of higher educated mothers. The p-value was .014 (95% CI of the difference-2.0 to -.23).

The differences in weights decreased as the levels of education approached each other as shown in (Table 33).

The influence of the mothers' education levels on Hb concentration was studied on all mothers. Using the Hb concentration as the dependant variable, the p-value was found to be .293 which was insignificant at 0.05 confidence levels.

The multiple comparisons between different strata showed no significant difference in Hb concentration of infants. This result indicated that Hb concentration of infants in this study group was not affected by the education of the mothers as seen in (Table 34).

Education of Mothers in Group A

The number of mothers who responded to the questionnaire was 50(87.7%).

The mothers were stratified in the same classes as before in the whole study group.

The distribution of the mothers according to education level is shown in (Figure 6).

When comparing the strata within Group A, using the weight as the dependant variable, the p-value was found to be 0.128 which is not significant at 0.05 levels.

The details of multiple comparisons showed that there was significant difference in infants' weights of illiterate mothers when they were compared to higher educated mothers, the p-value was .045 (95% CI -2.78 to -.029).

Again, the difference decreased as the level of education approached each other as shown in (Table 35).

The mean Z-scores of Group A was -.13 (95% CI of the mean -.57 to .31).

The mean Z- scores of the weights of infants of different mothers 'education levels were compared and the p-value was found to be .128, which indicated no significant difference in general.

In the multiple comparisons results there was a significant difference between illiterate and higher educated mothers, the p-value was .045 (95%CI of the mean -4.6 to -.059). This result indicated that the level of education of mothers affects the weights of infants in Group A who were given supplementary food at the age of four months.

The comparison of strata within Group A was conducted using the Hb concentration as the dependant variable. The p-value was found to be 0.074 which was of borderline significant at 0.05 levels and so there was some difference in Hb concentration of infants in all levels of education as shown in (Table 36).

Group A had introduced supplementary food at the age of four months and at the age of six months the mean of the nutrients that were consumed are determined for each infant as in (Table 37). Accordingly the mean quantity of nutrient consumed was calculated (Table 38).

It was found that the amount of protein consumed per day was 8.45gms (16.9% of the daily requirement).

The amount of carbohydrate consumed was 22.4gms (7.5% of the daily requirement). While the amounts of fats consumed was found to be 4.0gms (6.1% of daily requirement).

The amount of iron in the food offered to these infants was calculated to be 11.5microgram (65% of the daily requirement).

The education of the mothers did not affect the amount of nutrients consumed by the infants as the difference is insignificant (Tables 39, 40, 41, 42 & 43).

Education of Mothers in Group B

The number of mothers who responded to the questionnaire was 53 (89.8%).

The classification of the mothers in Group B according to the level of education is shown in (Figure 7).

Comparison of weights within the strata of Group B was done and the p-value was found to be .354 which was not significant at 0.05 confidence level. The details of multiple comparisons showed also no significant differences in infants' weights in the various levels of education as shown in (Table 44).

The mean of the Z-scores for Group B was found to be .354. When comparing the mean of the Z-scores of weights of infants at different levels of education the p-values were found to be significant.

This result indicates that the weights of the infants in Group B, who were exclusively breastfed for six months, were not affected by the levels of education of their mothers.

Using Hb concentration as the dependant variable the, mothers' education levels of the subgroups of Group B (BFe and BPb) were compared.

The mean Hb concentration of infants in all levels of the education of mothers of Group BPb was compared and the p-value was found to be.314 which is insignificant at .05 confidence level. In Group BFe the mean Hb concentration of infants at

different levels of education are compared and the p-value was found to be .163 which was insignificant at .05 confidence level.

So the Hb concentration of infants who were given iron supplement and those who were not given iron supplement are not affected by the education of the mothers.

The Expenditure of the Family

The distribution of families according to the expenditure is described in (Figure 8).

Using the weight as the dependant variable, the three categories of the whole study group are compared and the p-value was found to be .007 which is significant at .05 levels.

In the over all comparison the weights of infants whose families spend less than 50000Dinar per month were significantly lower than those who spend 50000 to 90000Dinar per month, this is shown in (Table 45).

The Expenditure of the Families in Group A

The distribution of the families in Group A according to expenditure is illustrated in (Figure 9)

Using the mean weight of each category as the dependant variable the three categories of Group A were compared.

The p-value was found to be .024 which indicates a significant difference.

From the details of comparisons the significant difference was between those whose families spend less than 50000 SD and the other categories. So the family expenditure did affect the infants' weights as seen in (Table 46).

When comparing the Z-scores of the categories the p-value was found to be also 024 which indicated significant difference.

Group A was the group which introduced supplementary food at the age of four months. The mean quantity of the nutrients consumed by each category was determined and the categories were compared.

When comparing the mean quantity of protein consumed by the various categories the p-value was found to be .011(95%CI of-14.7 to -2.9) as shown in (Table 47).

The amount of protein consumed by the infants in the first category was significantly lower than that amount consumed by the two other categories.

Again the amounts of carbohydrates consumed by the infants in the three categories were compared and the p-value was found to be .063 which indicated insignificant difference in over all effect.

The details of comparisons showed that there was a significant difference in the amount of carbohydrates consumed by the infants in the first category compared to the other two categories as evident in (Table 48).

The three categories were compared in terms of fats, energy and iron consumed and the results showed no significant difference between the categories as seen in (Tables 49, 50 & 51).

Using the Hb concentration as the dependant variable the three categories have been compared with each other. The p-value was found to be .389(95%CI -1.9 to .98).

So there is no difference in Hb concentration between infants of low family expenditure and those with high expenditure in Group A.

The Expenditure of the Families in Group B

The families in Group B had been categorized in the same way as Group A. The categories of Group B are illustrated in (Figure 10).

Using the weight as the dependant variable the mean weights of the three categories had been compared and the p-value was found to be .127 (95%CI-1.5 to .63).

Although there was no significant difference in the over all result, but in comparing the category of low expenditure with the other categories there appears significant difference, the p-value was found to be.043 (95%CI of-1.5 to -.o25).

The comparison of the categories using the mean Z-scores of Group B gave similar results as seen when using the mean weights. The results are shown in (Table 52).

The relationship of the family expenditure and the Hb concentration was detected and the p-value was found to be .529(95%CI -.96 to.57).

The comparisons of the categories reveal no effect of the expenditure of families on the Hb concentration levels and all the families shared the low level of Hb concentration.

The Family Size

The members of the families had been classified into three categories as shown in (Figure 11).

Using the weight as the dependant variable and the classes of the family size as the independent variables the p-value was found to be .648 (95%CI -.45 to .39). This result was insignificant and no difference is detected between families as evident in (Table 53).

Group A was classified into the main three classes as shown in (Figure 12).

Using the weight as the dependant variable and the various classes as the independent variables the p-value was found to be .396 (95%CI -.276 to .608).

The comparison of the mean Z-scores of weight-age for the different classes resulted in a p-value of .396 (95%CI -.4597 to 1.01). These results indicated that the family size had no effect on the weights of infants in Group A (Table 54).

The Hb concentration of infants was used as the dependant variable where the classes of the families were taken as the independent variables. The p-value was found to be

0.323 (95%CI of -.39 to 1.12). This result was statistically insignificant and showed no difference in Hb concentration between various families in Group A.

Group B was classified into three classes according to the size of the family as shown in (Figure 13). Using the weight as the dependant variable, the mean weights of the infants in various classes of family size were compared.

The p-value is found to be .542(95%CI-.973 to .777).

The comparison of the mean of the Z-scores of the various classes gave results similar to the result of the mean weights. The p-value was found to be .542(95%CI -1.62 to 1.29). (Table 55)

These results are insignificant and showed no differences

in weights of infants of various categories.

Using the Hb concentration as the dependant variable, and the categories of the family size as the independent variables, and by comparing of the categories of Group BPb the p-value was found to be.164.

The comparisons of the different categories of family size of Group BFe were found to have p-value of 0.116.

The results are insignificant. But the Hb concentration of infants in Group BFe who lived in small families showed higher Hb levels than the others as shown in (Table 56).

So the infants who were given iron supplement in the small families show better Hb concentration than infants in large families.

The following tables show: Weight, Length and Hemoglobin concentration of Infants Exclusively Breastfed for 6 Months Vs 4 Months

Group A Vs B

Table 1:

Weight of Group A Vs Group B at Birth

	N	Mean	Std.	Std. Error	Sig. (2-tailed)	Mean Difference	95% CI of the Difference	
							Lower	Upper
A	57	3.43	0.468	6.20E-02	0.737	-0.028	-1.196	0.139
B	59	3.46	0.448	5.80E-02				

Table 2:

Weight of Group A & Group B Vs Reference Value at Birth

Test Value = 3.2 Kg SD 0.4 kg								
	N	Mean	Std.	Std. Error	Sig. (2-tailed)	Mean Difference	95% CI of the Difference	
							Lower	Upper
A	57	3.43	0.468	6.20E-02	0.219	0.231	-0.107	0.356
B	59	3.46	0.448	5.80E-02	0.239	0.256	-0.139	0.373

Table 3:

Length of Group A Vs Group B at Birth

	N	Mean	Std.	Std. Error	Sig. (2-tailed)	Mean Difference	95% CI of the Difference	
							Lower	Upper
A	57	51.46	3.41	4.50E-01	0.140	0.81	-0.27	1.9
B	59	50.64	2.41	3.10E-01				

Table 4:

Length of Group A & Group B Vs Reference Value at Birth

	Test Value = 49.5 cm			SD 2.0 cm				
							95% CI of the Difference	
	N	Mean	Std.	Std. Error	Sig. (2-tailed)	Mean Difference	Lower	Upper
A	57	51.49	3.41	4.50E-01	0.336	1.96	-1.05	2.86
B	59	50.62	2.419	3.18E-01	0.212	1.12	-0.46	1.76

Table 5:

HB of Group A Vs Group B at Birth

							95% CI of the Difference	
	N	Mean	Std.	Std. Error	Sig. (2-tailed)	Mean Difference	Lower	Upper
A	57	17.13	1.834	2.43E-01	0.554	-0.203	-0.88	0.474
B	59	17.33	1.832	2.40E-01				

Table 6:

HB of Group A & Group B Vs Reference Value at Birth

	Test Value = 19.3 gm%			SD 2.2 gm%				
							95% CI of the Difference	
	N	Mean	Std.	Std. Error	Sig. (2-tailed)	Mean Difference	Lower	Upper
A	57	17.128	1.834	2.43E-01	0.339	-2.172	-2.658	0.685
B	59	17.331	1.832	2.41E-01	0.316	-1.969	-2.451	0.487

Table 7:

Weight of Group A Vs Group B at 4 Months

							95% CI of the Difference	
	N	Mean	Std.	Std. Error	Sig. (2-tailed)	Mean Difference	Lower	Upper
A	57	6.67	0.88	1.17E-01	0.373	0.066	-0.284	0.416
B	59	6.6	1.01	1.31E-01				

Table 8:

Weight of Group A & Group B Vs Reference Value at 4 Months

	Test Value = 6.7 Kg			SD 0.8 kg				
							95% CI of the Difference	
	N	Mean	Std.	Std. Error	Sig. (2-tailed)	Mean Difference	Lower	Upper
A	57	6.67	0.88	1.17E-01	0.806	-0.029	-0.264	0.206
B	59	6.6	1.01	1.32E-01	0.473	-0.095	-0.358	0.168

Table 9:

Length of Group A Vs Group B at 4 Months

							95% CI of the Difference	
	N	Mean	Std.	Std. Error	Sig. (2-tailed)	Mean Difference	Lower	Upper
A	57	64.956	2.62	3.47E-01	0.317	0.592	-0.574	1.757
B	59	64.365	3.62	4.70E-01				

Table 10:

Length of Group A & Group B Vs Reference Value at 4 Months

	Test Value = 63 cm			**SD 2.0 cm**				
							95% CI of the Difference	
	N	Mean	Std.	Std. Error	Sig. (2-tailed)	Mean Difference	Lower	Upper
A	57	64.96	2.62	3.47E-01	0.000	1.96	1.261	2.652
B	59	64.36	3.61	4.71E-01	0.005	1.365	0.422	2.307

Table 11:

HB of Group A Vs Group B at 4 Months

							95% CI of the Difference	
	N	Mean	Std.	Std. Error	Sig. (2-tailed)	Mean Difference	Lower	Upper
A	45	10.95	1.86	2.77E-02	0.952	0.022	-0.727	0.772
B	42	10.93	1.64	2.53E-01				

Table12:

HB of Group A & Group B Vs Reference Value at 4 Months

Test Value = 11.6 gm% SD 0.8 gm%								
							95% CI of the Difference	
	N	Mean	Std.	Std. Error	Sig. (2-tailed)	Mean Difference	Lower	Upper
A	45	10.9	1.86	2.77E-01	0.291	-0.651	-1.21	0.920
B	42	10.93	1.64	2.53E-01	0.299	-0.674	-1.185	0.163

Table 13:

Weight of Group A Vs Group B at 6 Months

							95% CI of the Difference	
	N	Mean	Std.	Std. Error	Sig. (2-tailed)	Mean Difference	Lower	Upper
A	57	8.37	7.42	9.83E-01	0.276	1.067	-0.866	3
B	59	7.3	1.06	1.38E-01				

Table 14:

Group A Vs Group B Weight-Age Z-Score at 6 Months

							95% CI of the Difference	
	N	Mean	Std.	Std. Error	Sig. (2-tailed)	Mean Difference	Lower	Upper
A	57	-0.225	1.529	2.03E-02	0.729	0.107	-0.502	0.715
B	59	-0.332	1.766	2.29E-01				

Table (15):

Weight and Length Gained by Infants in Two Months
Group A

Weight 4	Weight 6	Dif w	Length 4	Length 6	Dif l
5.2	5.2	0	62	65	3
6	7	0.95	68	70	2
6.3	6.3	0	70	70	0
7.1	7.5	0.4	63	65.5	2.5
6.4	6.5	0.1	61.5	67	5.5
6.1	7.2	1.1	67.5	70	2.5
6.4	6.9	0.5	66	70	4
7.2	7.8	0.6	64	68	4
5.8	6.3	0.5	58	63.5	5.5
6.3	7.2	0.9	64.5	67	2.5
5.9	7.3	1.45	64	65	1
5	6	1	58	61	3
6.4	7.8	1.4	65	67.5	2.5
6	6.7	0.7	62.5	65.5	3
8	8.5	0.5	70	76	6
5.9	7	1.15	63.5	65	1.5
5.4	6.6	1.2	61	65	4
6.8	7	0.2	65	70.5	5.5
8	8.4	0.4	65	67.5	2.5
6.3	7.1	0.8	59.5	66.5	7
4.8	5.6	0.8	60	61.5	1.5
8.3	9.6	1.3	70	76	6
5.5	6.3	0.8	58	60	2
6.1	6.1	0	64	67	3
7.5	7.1	-0.4	60	66	6
6.4	7.5	1.1	64	72	8
5.9	6.4	0.5	59.5	65	5.5
6.5	7.8	1.3	63.5	67.5	4
6.1	6.1	0	66	66.5	0.5
7.7	8.2	0.5	66.5	75.5	9
7.8	8.3	0.5	69.5	72.5	3
8.2	8	-0.2	63	69	6
5.7	6	0.3	65	66	1
6.9	7.1	0.2	66.5	67	0.5
6.4	7.1	0.7	63	66	3
5.5	5.9	0.4	65	68.5	3.5
6.2	7.8	1.6	68	69.5	1.5
5.1	5.2	0.1	59	61	2
6.8	8.5	1.7	63.5	70	6.5
6.8	8.5	1.7	63.5	69.5	6
6	6.5	0.5	60	65	5
7.8	8.8	1	60	68.5	8.5

8.2	9	0.85	67	71	4
6.3	7.1	0.8	62	65	3
8.1	9.5	1.4	70	72.5	2.5
5.4	6.5	1.1	63	68	5
7	7.6	0.6	66	69	3
6.3	6.5	0.2	64	66	2
6.5	7.5	1	62	69.5	7.5
9	9.4	0.4	75	82	7
6.6	7	0.4	63.5	66	2.5
6	7.5	1.5	65.5	67	1.5
8.5	8.5	0	70	72.5	2.5
6.2	6.7	0.5	65	68	3
5.8	7	1.2	63	67.5	4.5
5.5	6.8	1.35	67	70	3
8	9.5	1.5	71	76	5
8.5	7.5	-1	67	74	7
7.5	8.5	1	61	74	13

Descriptive statistics

	N	Mean
d_l_6_4_GA	57	3.0351
d_w_6_4_GA	57	0.7026
Valid N (listwise)	57	

Table (16)

Weight and Length Gained by Infants in Two Months
Groub B

Weight 4	Weight 6	Dif w	Length 4	Length 6	Dif l
5.2	5.2	0	62	65	3
6	7	0.95	68	70	2
6.3	6.3	0	70	70	0
7.1	7.5	0.4	63	65.5	2.5
6.4	6.5	0.1	61.5	67	5.5
6.1	7.2	1.1	67.5	70	2.5
6.4	6.9	0.5	66	70	4
7.2	7.8	0.6	64	68	4
5.8	6.3	0.5	58	63.5	5.5
6.3	7.2	0.9	64.5	67	2.5
5.9	7.3	1.45	64	65	1
5	6	1	58	61	3
6.4	7.8	1.4	65	67.5	2.5
6	6.7	0.7	62.5	65.5	3
8	8.5	0.5	70	76	6
5.9	7	1.15	63.5	65	1.5
5.4	6.6	1.2	61	65	4
6.8	7	0.2	65	70.5	5.5
8	8.4	0.4	65	67.5	2.5
6.3	7.1	0.8	59.5	66.5	7
4.8	5.6	0.8	60	61.5	1.5
8.3	9.6	1.3	70	76	6
5.5	6.3	0.8	58	60	2
6.1	6.1	0	64	67	3
7.5	7.1	-0.4	60	66	6
6.4	7.5	1.1	64	72	8
5.9	6.4	0.5	59.5	65	5.5
6.5	7.8	1.3	63.5	67.5	4
6.1	6.1	0	66	66.5	0.5
7.7	8.2	0.5	66.5	75.5	9
7.8	8.3	0.5	69.5	72.5	3
8.2	8	-0.2	63	69	6
5.7	6	0.3	65	66	1
6.9	7.1	0.2	66.5	67	0.5
6.4	7.1	0.7	63	66	3
5.5	5.9	0.4	65	68.5	3.5
6.2	7.8	1.6	68	69.5	1.5
5.1	5.2	0.1	59	61	2
6.8	8.5	1.7	63.5	70	6.5
6.8	8.5	1.7	63.5	69.5	6
6	6.5	0.5	60	65	5
7.8	8.8	1	60	68.5	8.5

8.2	9	0.85	67	71	4
6.3	7.1	0.8	62	65	3
8.1	9.5	1.4	70	72.5	2.5
5.4	6.5	1.1	63	68	5
7	7.6	0.6	66	69	3
6.3	6.5	0.2	64	66	2
6.5	7.5	1	62	69.5	7.5
9	9.4	0.4	75	82	7
6.6	7	0.4	63.5	66	2.5
6	7.5	1.5	65.5	67	1.5
8.5	8.5	0	70	72.5	2.5
6.2	6.7	0.5	65	68	3
5.8	7	1.2	63	67.5	4.5
5.5	6.8	1.35	67	70	3
8	9.5	1.5	71	76	5
8.5	7.5	-1	67	74	7
7.5	8.5	1	61	74	13

Descriptive statistics

	N	Mean
d_l_6_4_GB	59	3.9915
d_w_6_4_GB	59	0.6958
Valid N (listwise)	59	

Table 17:

Group A Vs Group B Monthly Weight-Gain (4-6 Months)

	N	Mean	Std.	Std. Error	Sig. (2-tailed)	Mean Difference	95% CI of the Difference	
							Lower	Upper
A	57	0.35	0.302	3.90E-02	0.949	0.003	-0.104	0.111
B	59	0.348	0.281	3.60E-02				

Table 18:

Group A and B Weight- Age Incidences < -2 sd

				Total
		< -2 sd	> -2 sd	
group	A	10	47	57
	B	13	46	59
Total		23	93	116

Table 19:

Chi-Square Tests for Weight- Age Incidences < -2 sd

	Value	**df**	**Asymp. sig.**	**Exact Sig. (2-sided)**	**Exact Sig. (1-sided)**
Pearson Chi-Square	0.367683577	1	0.54426963		
Continuity Correction(a)	0.139471745	1	0.70880673		
Likelihood Ratio	0.368689955	1	0.54371922		
Fisher's Exact Test				0.643493	0.354980057
Linear-by-Linear Ass.	0.364513891	1	0.54600996		
N of Valid Cases	116				
a	Computed only for a 2x2 table				
b	0 cells (.0%) have expected count less than 5. The minimum expected count is 11.30.				

Table 20:

Length of Group A Vs Group B at 6 Months

	N	Mean	Std.	Std. Error	Sig. (2-tailed)	Mean Difference	95% CI of the Difference	
							Lower	Upper
A	57	67.99	2.67	3.54E-01	0.571	-0.365	-1.637	0.908
B	59	68.36	4.07	5.31E-01				

Table 21:

Group A Vs Group B Monthly Length-Gain (4-6 Months)

	N	Mean	Std.	Std. Error	Sig. (2-tailed)	Mean Difference	95% CI of the Difference	
							Lower	Upper
A	57	1.517	1.012	1.34E-01	0.024	-0.478	-0.892	-0.064
B	59	1.995	1.224	1.59E-01				

Table 22:

Group A Vs Group B Length-Age Z-Score at 6 Months

	N	Mean	Std.	Std. Error	Sig. (2-tailed)	Mean Difference	95% CI of the Difference	
							Lower	Upper
A	57	0.996	1.336	1.77E-01	0.571	-0.182	-0.819	0.454
B	59	1.178	2.039	2.65E-01				

Table 23:

Group A and B Length- Age Incidencies < -2 sd

				Total
		< -2 sd	> -2 sd	
group	A	0	57	57
	B	4	55	59
Total		4	112	116

Table 24:

Chi-Square Tests for Length- Age Incidences < -2 sd

	Value	df	Asymp. sig.	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.002421308	1	0.04543495		
Continuity Correction(a)	2.22510726	1	0.13578323		
Likelihood Ratio	5.546409161	1	0.01851864		
Fisher's Exact Test				0.11873	0.063562909
Linear-by-Linear Ass	3.967917676	1	0.04637509		
N of Valid Cases	116				
A	Computed only for a 2x2 table				
B	2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.97.				

Table 25:

Group A Vs Group B Weight-Length Z-score at 6 Months

	N	Mean	Std.	Std. Error	Sig. (2-tailed)	Mean Difference	95% CI of the Difference	
							Lower	Upper
A	57	-4.948	9.802	1.30E+00	0.130	2.564	-0.7699	5.897
B	59	-7.512	8.284	1.08E+00				

Table 26:

Group A and B Weight to Length incidences < -2 sd

				Total
		< -2 sd	> -2 sd	
group	A	49	8	57
	B	46	13	59
Total		95	21	116

Table 27:

Chi-Square Tests for Group A and B Weight to Length incidences < -2 sd

	Value	df	Asymp. sig.	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.251102183	1	0.26334207		
Continuity Correction(a)	0.769756088	1	0.38029252		
Likelihood Ratio	1.262255287	1	0.26122463		
Fisher's Exact Test				0.336818	0.190412 83
Linear-by-Linear Ass.	1.240316819	1	0.26541		
N of Valid Cases	116				
a	Computed only for a 2x2 table				
b	0 cells (.0%) have expected count less than 5. The minimum expected count is 10.32.				

Table 28:

The Hb concentration of Group A, Group BPb and Group BFe

Reference Value 11.5gm% SD .8gm%									
							95%CI of the Mean		
	N	Mean	Std.	Std. Error	Minimum	Maximum	Lower	Upper	Sig.
A	45	10.578	1.657	2.47E-01	6.800	15	10.08	11.07	0.394
BPb	19	10.258	1.599	3.67E-01	6.800	13.7	9.49	11.029	0.439
Bfe	18	10.383	0.778	1.83E-01	9.000	11.6	9.994	10.77	0.414
Total	82	10.461	1.485	1.64E-01	6.800	15	10.13	10.78	

Table 29:

Hb concentration of Infants in Group A VS Group BPb VS Group Bfe

(I)Group	(J)Group	Mean Difference (I -J)	Std Error	Sig.	95%CI of the Difference	
					Lower Bound	Upper Bound
A	BPb	0.3199	4.09E-01	0.437	-0.496	1.136
	Bfe	0.1944	6.46E-01	0.643	-0.637	1.026
BPb	A	-0.3199	4.09E-01	0.437	-1.136	0.456
	BFe	-0.1254	4.92E-01	0.800	-1.106	0.855
Bfe	A	-0.1944	4.17E-01	0.643	-1.026	0.637
	BPb	0.1254	4.92E-01	0.800	-0.855	1.106

All effect p-value 0.716

Table 30:

Group A , BPb and Bfe Hb concentration Incidences < -2 sd

				Total
		< -2 sd	> -2 sd	
group	A	14	31	45
	BPb	7	13	20
	Bfe	6	12	18
Total		27	56	83

Table 31:

Chi-Square Tests for Group A , BPb and Bfe Hb concentration Incidences < -2 sd

	Value	df	Asymp.Sig. (2-sided)
Pearson Chi-Square	0.102164168	2	0.95020067
Likelihood Ratio	0.101772976	2	0.95038654
Linear-by-Linear	0.050918577	1	0.82147252
N of Valid Cases	83		
a	0 cells (.0%) have expected count less than 5. The minimum expected count is 5.86.		

Table 32 & 33:

Comparison of Weights of Infants in Relation to Mother's Education in All Groups

Dependent Variable: Wt in kg
LSD

Education Level (I)	education level (J)	mean difference	std. error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Illiterate	elementry	-0.84935897	0.4467747	0.060198	-1.73585691	0.037138958
	secondary	-0.69326241	0.42765077	0.108178	-1.54181433	0.155289503
	higher	-1.125	0.4502516	0.014115	-2.01839685	-0.231603147
elementry	illiterate	0.849358974	0.4467747	0.060198	-0.03713896	1.735856907
	secondary	0.156096563	0.2411025	0.518853	-0.3223031	0.634496225
	higher	-0.27564103	0.27923419	0.325984	-0.82970223	0.278420182
secondary	illiterate	0.693262411	0.42765077	0.108178	-0.1552895	1.541814326
	elementry	-0.15609656	0.2411025	0.518853	-0.63449623	0.322303099
	higher	-0.43173759	0.24748593	0.084177	-0.92280336	0.05932818
Higher	illiterate	1.125	0.4502516	0.014115	0.231603147	2.018396853
	elementry	0.275641026	0.27923419	0.325984	-0.27842018	0.829702234
	secondary	0.431737589	0.24748593	0.084177	-0.05932818	0.922803358
*	The mean difference is significant at the .05 level.					

All effect p-value = 0.074

Table 34:

Comparison of Hb concentration of Infants in Relation to Mother's Education All Groups

Dependent Variable: Hb/g
LSD

education level(I)	education level (J)	Mean difference	std. error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
illiterate	elementary	1.169473684	0.7012569	0.099606	-0.22781118	2.56675855
	secondary	0.610555556	0.66586932	0.362158	-0.71621802	1.937329129
	Higher	0.541111111	0.70530342	0.445402	-0.86423663	1.946458853
elementary	illiterate	-1.16947368	0.7012569	0.099606	-2.56675855	0.227811182
	secondary	-0.55891813	0.39562764	0.161925	-1.3472234	0.229387143
	Higher	-0.62836257	0.45890325	0.175056	-1.54274726	0.286022117
secondary	illiterate	-0.61055556	0.66586932	0.362158	-1.93732913	0.716218018
	elementary	0.558918129	0.39562764	0.161925	-0.22938714	1.3472234
	Higher	-0.06944444	0.40275663	0.863576	-0.87195456	0.733065669
higher	illiterate	-0.54111111	0.70530342	0.445402	-1.94645885	0.864236631
	elementary	0.628362573	0.45890325	0.175056	-0.28602212	1.542747264
	secondary	0.069444444	0.40275663	0.863576	-0.73306567	0.871954558

All effect p-value = 0.293

Table 35:

Comparison of Weights of Infants in Relation to Mother's Education

In Group A

Dependent Variable: Wt in kg

LSD

education level (I)	Education level (J)	mean difference	std. error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
illiterate	Elementary	-0.78846154	0.68267181	0.25407	-2.16260861	0.585685535
	Secondary	-0.91363636	0.66379243	0.175365	-2.24978122	0.422508493
	Higher	-1.40384615	0.68267181	0.045442	-2.77799323	-0.02969908
elementry	Illiterate	0.788461538	0.68267181	0.25407	-0.58568554	2.162608612
	Secondary	-0.12517483	0.31441555	0.692384	-0.7580605	0.507710852
	Higher	-0.61538462	0.3525302	0.087553	-1.32499111	0.094221882
secondary	Illiterate	0.913636364	0.66379243	0.175365	-0.42250849	2.249781221
	Elementary	0.125174825	0.31441555	0.692384	-0.50771085	0.758060502
	Higher	-0.49020979	0.31441555	0.125824	-1.12309547	0.142675887
higher	Illiterate	1.403846154	0.68267181	0.045442	0.02969908	2.777993227
	Elementary	0.615384615	0.3525302	0.087553	-0.09422188	1.324991113
	Secondary	0.49020979	0.31441555	0.125824	-0.14267589	1.123095467
*	The mean difference is significant at the .05 level.					

All effect p-value = 0.128

Table 36:

Comparison of Hb Concentration of Infants in Relation to Mothers Education

Group A

Hb/g

	N	**Mean**	**Std. Deviation**	**Std. Error**	**95% Confidence Interval for Mean**		**Minimum**	**Maximum**	**Sig.**
					Lower Bound	Upper Bound			
Illiterate	1	11.1000	.	.	.	.	11.10	11.10	.074
Elementary	11	9.8818	1.17031	.35286	9.0956	10.6680	8.50	12.00	
Secondary	18	11.0056	1.54176	.36340	10.2389	11.7723	7.90	15.00	
Higher	11	11.4455	1.34712	.40617	10.5404	12.3505	9.00	14.00	
Total	41	10.8244	1.47424	.23024	10.3591	11.2897	7.90	15.00	

Table 37:

Quantity of Nutrients Consumed by Infants

Card Number	PROTEIN	CARBO	FATS	ENERGY	Fe_mg
105	19.768	30.265	4.62	233.35	29.4075
114	5.248	18.559	2.89	116.945	0.8675
120	10.325	30.638	13.275	278.195	51.4875
126	12.225	26.956	0.4875	153.875	4.5375
128	7.213	30.136	4.4038	186.395	1.575
139	14.094	31.025	12.5875	284.875	16.9813
141	13.444	28.569	1.725	178.375	16.925
159	11.523	26.508	13.4563	264.65	28.2063
161	7.628	14.634	2.9075	111.925	12.0413
162	12.775	34.4	13.025	303.075	2.6625
173	6.83	29.084	3.6313	170.325	1.5548
182	12.376	36.398	1.4463	201.4	3.9663
185	3.3	14.369	0.5063	72.4	0.5756
195	12.57	26.394	9.62	235.9625	2.9438
198	12.843	29.331	3.5488	192.785	28.5528
201	8.913	28.695	2.125	162.05	1.963
205	9.788	25.569	6.2463	191.5063	39.3503
229	8.455	24.924	1.5538	143.95	2.9313
230	4.906	12.863	0.925	77.6875	1.5375
234	5.31	10.959	6.3513	119.825	0.4063
248	4.381	14.445	0.5	74.65	1.7
252	14.105	44.429	2.2913	245.9625	5.2253
263	5.698	12.003	1.52	82.8625	14.0625
285	11.121	20.62	9.4538	207.2813	50.8288
286	8.255	17.515	2.8755	123.0775	26.9325
316	8.271	16.123	5.2838	142.5	51.5663
319	3.248	7.49	1.8425	57.275	0.4938
324	11.174	38.063	3.4125	218.6813	2.6135
328	1.948	9.865	1.5763	59.875	0.2438
329	5.378	9.375	3.4688	89.3225	25.335
338	14.643	42.924	3.58	253.6875	4.4565
345	17.104	37.448	6.3663	267.9125	54.65

346	12.334	43.776	7.2688	270.1125	29.105
366	9.886	23.459	2.4925	146.3875	14.85
372	1.845	8.913	2.5625	65.775	0.16
380	2.27	4.84	1.0288	36.575	0.2925
381	8.133	20.088	3.9788	145.875	2.0788
382	12.588	31.936	5.9913	227.225	3.699
387	4.84	10.565	0.24	62.55	1.605
393	3.325	9.735	1.04	58.925	0.875
394	8.383	26.706	2.7375	161.125	2.4463
414	5.713	15.985	3.2875	113.2625	2.0375
433	2.11	8.481	1.6788	56.925	0.1
443	3.961	16.759	3.0375	108.2125	0.8413
455	8.184	25.473	1.9375	147.3	3.1775
456	8.115	20.744	3.67	144.125	2.0038
481	0.563	0.613	0.0188	4.625	0.0938
484	8.348	28.276	5.56	190.6438	1.3938

Table 38:

Percentage of Daily consumed Nutrients

Nutrients	Mean	Daily Requirements	Percentage
Protein	8.45E+00	50gms	16.90%
Carbohydrates	2.24E+01	300gms	7.50%
Fats	4.00E+00	65gms	6.10%
Energy	155.o	600 Kcal	25.8%
Iron	11.49mgs	18mgs	65%

Table 39:

Comparison of Protein consumption in Relation to education

Group A

Dependent Variable: PROTEIN

LSD

education level (I)	education level (J)	mean difference	std. error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
illiterate	elementary	-2.323225	3.36512605	0.494262	-9.14161805	4.495168048
	secondary	-0.27401667	3.31670445	0.934601	-6.99429823	6.446264892
	Higher	0.323841667	3.36512605	0.923854	-6.49455138	7.142234715
Elementary	Illiterate	2.323225	3.36512605	0.494262	-4.49516805	9.141618048
	secondary	2.049208333	1.70643036	0.237432	-1.408348	5.50676467
	Higher	2.647066667	1.79873554	0.149577	-0.99751772	6.291651054
secondary	Illiterate	0.274016667	3.31670445	0.934601	-6.44626489	6.994298225
	Elementary	-2.04920833	1.70643036	0.237432	-5.50676467	1.408348004
	Higher	0.597858333	1.70643036	0.728058	-2.859698	4.05541467
higher	Illiterate	-0.32384167	3.36512605	0.923854	-7.14223471	6.494551382
	Elementary	-2.64706667	1.79873554	0.149577	-6.29165105	0.997517721
	secondary	-0.59785833	1.70643036	0.728058	-4.05541467	2.859698004

All effect p-value = 0.490

Table 40:

Comparison of Carbohydrate consumption in Relation to education

Group A

Dependent Variable: CARBO

LSD

education level (I)	education level (J)	mean difference	std. error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
illiterate	elementry	-1.19155833	8.53814266	0.889767	-18.4914786	16.10836197
	secondary	1.052363333	8.41528528	0.901158	-15.9986243	18.10335094
	higher	0.6995	8.53814266	0.935147	-16.6004203	17.9994203
elementry	illiterate	1.191558333	8.53814266	0.889767	-16.108362	18.49147863
	secondary	2.243921667	4.32962856	0.607355	-6.52873908	11.01658241
	higher	1.891058333	4.56382922	0.681005	-7.35613803	11.1382547
secondary	illiterate	-1.05236333	8.41528528	0.901158	-18.1033509	15.99862427
	elementry	-2.24392167	4.32962856	0.607355	-11.0165824	6.528739081
	higher	-0.35286333	4.32962856	0.935484	-9.12552408	8.419797415
higher	illiterate	-0.6995	8.53814266	0.935147	-17.9994203	16.6004203
	elementry	-1.89105833	4.56382922	0.681005	-11.1382547	7.356138035
	secondary	0.352863333	4.32962856	0.935484	-8.41979741	9.125524081

All effect p-value = 0.960

Table 41:

Comparison of Fats consumption in Relation to education

Group A

Dependent Variable: FATS

LSD

Education level (I)	Education level (J)	mean difference	std. error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
illiterate	elementary	-1.21184167	2.64403367	0.649396	-6.56916276	4.145479422
	secondary	-1.19035	2.60598803	0.650503	-6.47058331	4.089883313
	Higher	-0.61169167	2.64403367	0.818319	-5.96901276	4.745629422
Elementary	Illiterate	1.211841667	2.64403367	0.649396	-4.14547942	6.569162755
	secondary	0.021491667	1.34076978	0.987297	-2.69516596	2.738149294
	higher	0.60015	1.41329544	0.673554	-2.26345857	3.463758575
secondary	illiterate	1.19035	2.60598803	0.650503	-4.08988331	6.470583313
	elementary	-0.02149167	1.34076978	0.987297	-2.73814929	2.69516596
	Higher	0.578658333	1.34076978	0.668546	-2.13799929	3.29531596
higher	Illiterate	0.611691667	2.64403367	0.818319	-4.74562942	5.969012755
	elementary	-0.60015	1.41329544	0.673554	-3.46375857	2.263458575
	secondary	-0.57865833	1.34076978	0.668546	-3.29531596	2.137999294

All effect p-value = 0.939

Table 42:

Comparison of Energy consumption in Relation to education

Group A

Dependent Variable: ENERGY

LSD

Education level (I)	education level (J)	mean difference	std. error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Illiterate	elementary	-23.9113583	57.8416573	0.681705	-141.109688	93.28697171
	secondary	-7.40334	57.0093598	0.897379	-122.915275	108.1085952
	Higher	0.422808333	57.8416573	0.994207	-116.775522	117.6211384
Elementary	Illiterate	23.91135833	57.8416573	0.681705	-93.2869717	141.1096884
	secondary	16.50801833	29.3310737	0.576954	-42.922382	75.93841871
	Higher	24.33416667	30.9176663	0.436257	-38.3109758	86.97930914
Secondary	Illiterate	7.40334	57.0093598	0.897379	-108.108595	122.9152752
	elementary	-16.5080183	29.3310737	0.576954	-75.9384187	42.92238204
	Higher	7.826148333	29.3310737	0.791088	-51.604252	67.25654871
Higher	Illiterate	-0.42280833	57.8416573	0.994207	-117.621138	116.7755217
	elementary	-24.3341667	30.9176663	0.436257	-86.9793091	38.31097581
	secondary	-7.82614833	29.3310737	0.791088	-67.2565487	51.60425204

All effect p-value = 0.876

Table 43:

Comparison of Iron consumption in Relation to education

Group A

Dependent Variable: Fe_mg

LSD

education level (I)	education level (J)	mean difference	std. error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
illiterate	elementary	-16.9999917	12.7533896	0.190689	-42.8408135	8.840830136
	secondary	-8.20516333	12.569878	0.517944	-33.6741554	17.2638287
	Higher	-7.08446667	12.7533896	0.581898	-32.9252885	18.75635514
elementary	Illiterate	16.99999167	12.7533896	0.190689	-8.84083014	42.84081347
	secondary	8.794828333	6.46714887	0.182084	-4.30885996	21.89851663
	higher	9.915525	6.81697346	0.15423	-3.89697525	23.72802525
secondary	illiterate	8.205163333	12.569878	0.517944	-17.2638287	33.67415536
	elementary	-8.79482833	6.46714887	0.182084	-21.8985166	4.308859962
	Higher	1.120696667	6.46714887	0.863368	-11.9829916	14.22438496
Higher	Illiterate	7.084466667	12.7533896	0.581898	-18.7563551	32.92528847
	elementary	-9.915525	6.81697346	0.15423	-23.7280253	3.896975254
	secondary	-1.12069667	6.46714887	0.863368	-14.224385	11.98299163

All effect p-value = 0.353

Table 44:

Comparison of Weights of Infants in Relation to Mother's Education

In Group B

Dependent Variable: Wt in kg

LSD

education level(I)	education level (J)	mean difference	std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
illiterate	elementry	-0.97692308	0.61791829	0.120314	-2.21867637	0.264830216
	secondary	-0.55	0.58197893	0.34927	-1.71953044	0.619530441
	higher	-0.88636364	0.63099737	0.166418	-2.15440033	0.381673062
elementry	illiterate	0.976923077	0.61791829	0.120314	-0.26483022	2.21867637
	secondary	0.426923077	0.36953738	0.253574	-0.3156901	1.169536251
	higher	0.090559441	0.44273705	0.838775	-0.79915396	0.980272845
secondary	illiterate	0.55	0.58197893	0.34927	-0.61953044	1.719530441
	elementry	-0.42692308	0.36953738	0.253574	-1.16953625	0.315690097
	higher	-0.33636364	0.39101477	0.39385	-1.12213724	0.449409966
Higher	illiterate	0.886363636	0.63099737	0.166418	-0.38167306	2.154400335
	elementry	-0.09055944	0.44273705	0.838775	-0.98027284	0.799153963
	secondary	0.336363636	0.39101477	0.39385	-0.44940997	1.122137239

All effect p-value = 0.354

Table 45:

Comparison of Weights of Infants in Relation to Family Expenditure

All Groups

Dependent Variable: Wt in kg

LSD

Expenditure SD (I)	expenditure SD (J)	mean difference	std. error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
< 50,000	50,000-90,000	-0.71723821	0.23294092	0.002687	-1.17944354	-0.255032881
	>= 100,000	-0.54278169	0.36208817	0.137047	-1.26124318	0.175679797
50,000-90,000	< 50,000	0.717238212	0.23294092	0.002687	0.255032881	1.179443542
	>= 100,000	0.174456522	0.39851704	0.662511	-0.61628774	0.965200787
>= 100,000	< 50,000	0.54278169	0.36208817	0.137047	-0.1756798	1.261243178
	50,000-90,000	-0.17445652	0.39851704	0.662511	-0.96520079	0.616287743
*	The mean difference is significant at the .05 level.					

All effect p-value = 0.007

Table 46:

Comparison of Weights of Infants in Relation to Family Expenditure

Group A

Dependent Variable: Wt in kg

LSD

Expenditure SD (I)	expenditure SD (J)	mean difference	std. error	Sig.	95% Confidence Interval Lower Bound	 Upper Bound
< 50,000	50,000-90,000	-0.67303922	0.29312883	0.026178	-1.26273836	-0.083340071
	>= 100,000	-0.93970588	0.46145786	0.047368	-1.86803935	-0.011372415
50,000-90,000	< 50,000	0.67303922	0.29312883	0.026178	0.083340071	1.26273836
	>= 100,000	-0.26666667	0.50402151	0.599241	-1.28062717	0.747293832
>= 100,000	< 50,000	0.93970588	0.46145786	0.047368	0.011372415	1.868003935
	50,000-90,000	0.26666667	0.50402151	0.599241	-0.74729383	1.280627165
	The mean difference is significant at the .05 level.					

All effect p-value = 0.024

Table 47:

Comparison of protein consumption in Relation to Family Expenditure

Group A

Dependent Variable: PROTEIN

LSD

expenditure SD (I)	expenditure SD (J)	mean difference	std. error	Sig.	95% Confidence Interval Lower Bound	 Upper Bound
< 50,000	50,000-90,000	-2.03190242	1.58266974	0.20697	-5.23584981	1.172044971
	>= 100,000	-8.82922742	2.91168884	0.004356	-14.7236333	-2.934821528
50,000-90,000	< 50,000	2.031902419	1.58266974	0.20697	-1.17204497	5.235849809
	>= 100,000	-6.797325	3.15517786	0.037618	-13.1846486	-0.410001364
>= 100,000	< 50,000	8.829227419	2.91168884	0.004356	2.934821528	14.72363331
	50,000-90,000	6.797325	3.15517786	0.037618	0.410001364	13.18464864
	. The mean difference is significant at the .05 level					

All effect p-value = 0.011

Table 48:

Comparison of Carbohydrate consumption in Relation to Family Expenditure

Group A

Dependent Variable: CARBO

LSD

expenditure SD (I)	expenditure SD (J)	mean difference	std. error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
< 50,000	50,000-90,000	-5.95675806	4.08452104	0.152954	-14.2254386	2.311922485
	>= 100,000	-15.7956581	7.51442578	0.042232	-31.0078178	-0.583498371
50,000-90,000	< 50,000	5.956758065	4.08452104	0.152954	-2.31192248	14.22543861
	>= 100,000	-9.8389	8.14281715	0.234401	-26.3231715	6.64537152
>= 100,000	< 50,000	15.79565806	7.51442578	0.042232	0.583498371	31.00781776
	50,000-90,000	9.8389	8.14281715	0.234401	-6.64537152	26.32317152
	The mean difference is significant at the .05 level.					

All effect p-value = 0.063

Table 49:

Comparison of Fats consumption in Relation to Family Expenditure

Group A

Dependent Variable: FATS

LSD

expenditure SD (I)	expenditure SD (J)	mean difference	std. error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
< 50,000	50,000-90,000	0.79263871	1.35429774	0.561822	-1.94899373	3.534271146
	>= 100,000	0.91668871	2.49154546	0.714975	-4.12718137	5.960558792
50,000-90,000	< 50,000	-0.79263871	1.35429774	0.561822	-3.53427115	1.948993727
	>= 100,000	0.12405	2.69990012	0.963594	-5.34161205	5.589712051
>= 100,000	< 50,000	-0.91668871	2.49154546	0.714975	-5.96055879	4.127181373
	50,000-90,000	-0.12405	2.69990012	0.963594	-5.58971205	5.341612051

All effect p-value = 0.805

Table 50:

Comparison of Energy consumption in Relation to Family Expenditure

Group A

Dependent Variable: ENERGY

LSD

Expenditure SD (I)	expenditure SD (J)	mean difference	std. error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
< 50,000	50,000-90,000	-20.9037565	28.8224957	0.472736	-79.2518485	37.44433558
	>= 100,000	-85.7076565	53.0256798	0.114293	-193.052533	21.63722022
50,000-90,000	< 50,000	20.90375645	28.8224957	0.472736	-37.4443356	79.25184848
	>= 100,000	-64.8039	57.4599347	0.266471	-181.125457	51.5176565
>= 100,000	< 50,000	85.70765645	53.0256798	0.114293	-21.6372202	193.0525331
	50,000-90,000	64.8039	57.4599347	0.266471	-51.5176565	181.1254565

All effect p-value = 0.246

Table 51:

Comparison of Iron consumption in Relation to Family Expenditure

Group A

Dependent Variable: Fe_mg

LSD

Expenditure SD (I)	expenditure SD (J)	mean difference	std. error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
< 50,000	50,000-90,000	-2.23637419	6.79881537	0.74401	-15.9998563	11.52710796
	>= 100,000	-5.75757419	12.5080011	0.647916	-31.0786985	19.56355016
50,000-00,000	< 50,000	2.236374194	6.79881537	0.74401	-11.527108	15.99985634
	>= 100,000	-3.5212	13.5539785	0.796428	-30.959795	23.91739501
>= 100,000	< 50,000	5.757574194	12.5080011	0.647916	-19.5635502	31.07869854
	50,000-90,000	3.5212	13.5539785	0.796428	-23.917395	30.95979501

All effect p-value = 0.866

Table 52:

Comparison of Hb concentration of Infants in Relation to Family Expenditure

All Groups

Dependent Variable: Wt in kg

LSD

Expenditure SD (I)	expenditure SD (J)	mean difference	std. error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
< 50,000	50,000-90,000	-0.1442	0.4108	0.726	-0.9628	0.6743
	>= 100,000	0.572	0.5659	0.315	-0.5557	1.699
50,000-90,000	< 50,000	0.144	0.4108	0.726	-0.6743	0.9628
	>= 100,000	0.717	0.6455	0.271	-0.5701	2.0025
>= 100,000	< 50,000	-0.572	0.5659	0.315	-1.699	0.5557
	50,000-90,000	-0.717	0.6455	0.271	-2.002	0.5701
*	The mean difference is significant at the .05 level.					

All effect p-value = 0.529

Table 53:

Comparison of Weights of Infants in Relation to Family Size

All Groups

Dependent Variable: Wt in kg

LSD

family members (I)	family members (J)	mean difference	std. error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
<=4	5-8	-0.02697146	0.21437963	0.900136	-0.45234716	0.398404248
	>8	0.297179487	0.36018497	0.411313	-0.41750564	1.011864611
5-8	<=4	0.026971456	0.21437963	0.900136	-0.39840425	0.452347161
	>8	0.324150943	0.35034199	0.35709	-0.37100357	1.019305455
>8	<=4	-0.29717949	0.36018497	0.411313	-1.01186461	0.417505637
	5-8	-0.32415094	0.35034199	0.35709	-1.01930546	0.371003568

All effect p-value = 0.648

Table 54:

Comparison of Weights of Infants in Relation to Family Size

Group A

Dependent Variable: Wt in kg

LSD

Family members (I)	family members (J)	mean difference	std. error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
<=4	5-8	0.291578947	0.28204074	0.306511	-0.27581384	0.858971732
	>8	0.531578947	0.43396019	0.226698	-0.34143635	1.404594245
5-8	<=4	-0.29157895	0.28204074	0.306511	-0.85897173	0.275813837
	>8	0.24	0.42127679	0.571597	-0.60749958	1.087499582
>8	<=4	-0.53157895	0.43396019	0.226698	-1.40459425	0.341436351
	5-8	-0.24	0.42127679	0.571597	-1.08749958	0.607499582

All effect p-value = 0.396

Table 55:

Comparison of Weights of Infants in Relation to Family Size

Group B

Dependent Variable: Wt in kg

LSD

Family members (I)	family members (J)	mean difference	std. error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
<=4	5-8	-0.32535714	0.32231496	0.317723	-0.9730733	0.322359016
	>8	0.08	0.60299607	0.894997	-1.13176598	1.291765976
5-8	<=4	0.325357143	0.32231496	0.317723	-0.32235902	0.973073302
	>8	0.405357143	0.58846391	0.494173	-0.77720536	1.587919647
>8	<=4	-0.08	0.60299607	0.894997	-1.29176598	1.131765976
	5-8	-0.40535714	0.58846391	0.494173	-1.58791965	0.777205362

All effect p-value = 0.542

Table 56:

Comparison of Hb concentration of Infants in Relation to Family Size

All Groups

Dependent Variable: Hb/g

LSD

Family members (I)	family members (J)	mean difference	std. error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
<=4	5-8	0.376567944	0.34773983	0.282368	-0.31631879	1.069454677
	>8	0.260714286	0.56862778	0.647939	-0.8723013	1.393729875
5-8	<=4	-0.37656794	0.34773983	0.282368	-1.06945468	0.316318788
	>8	-0.11585366	0.54822893	0.833216	-1.20822365	0.976516336
>8	<=4	-0.26071429	0.56862778	0.647939	-1.39372987	0.872301303
	5-8	0.115853659	0.54822893	0.833216	-0.97651634	1.208223653

All effect p-value = 0.558

Figures describe Socio-economic Factor of the Study Groups (A & B)

Figure (1)

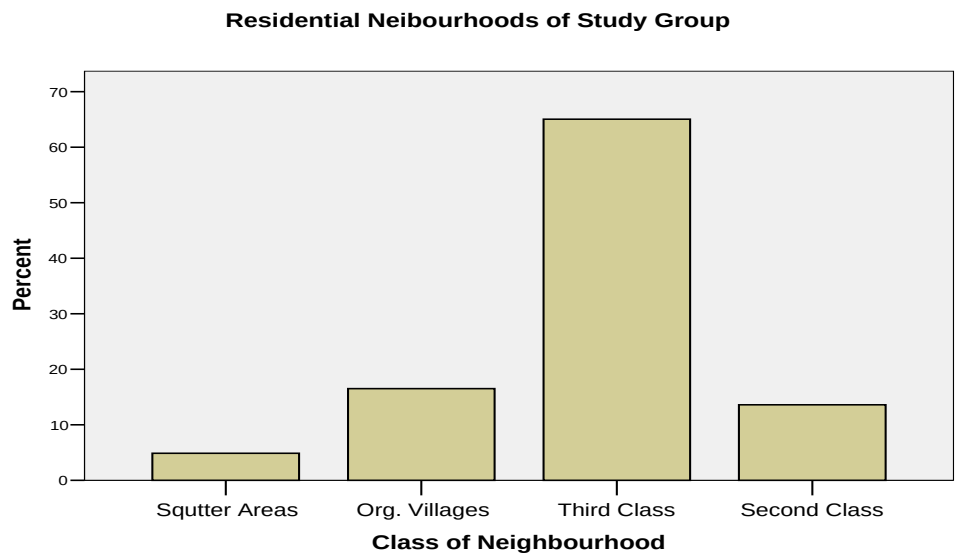


Figure (2)

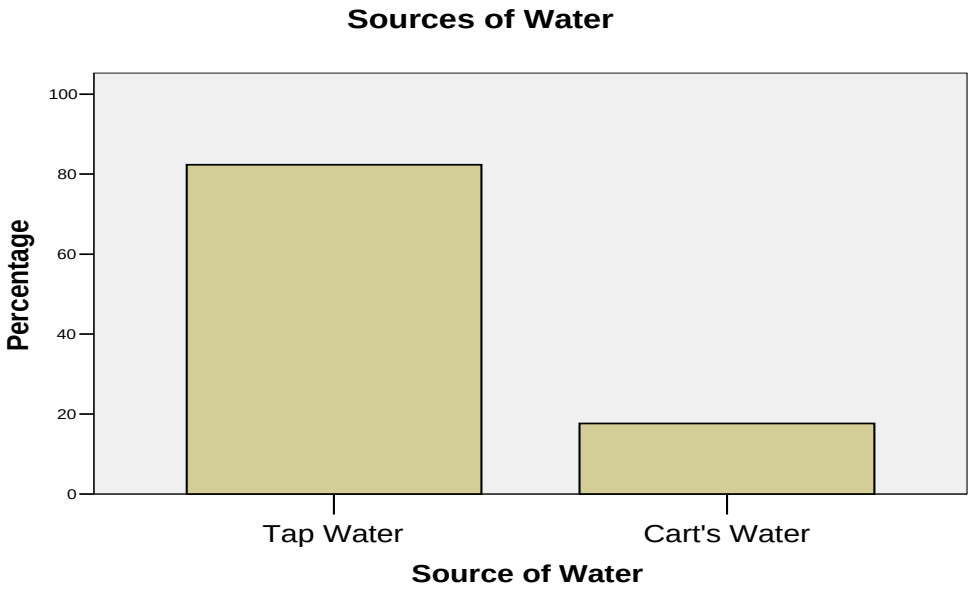


Figure (3)

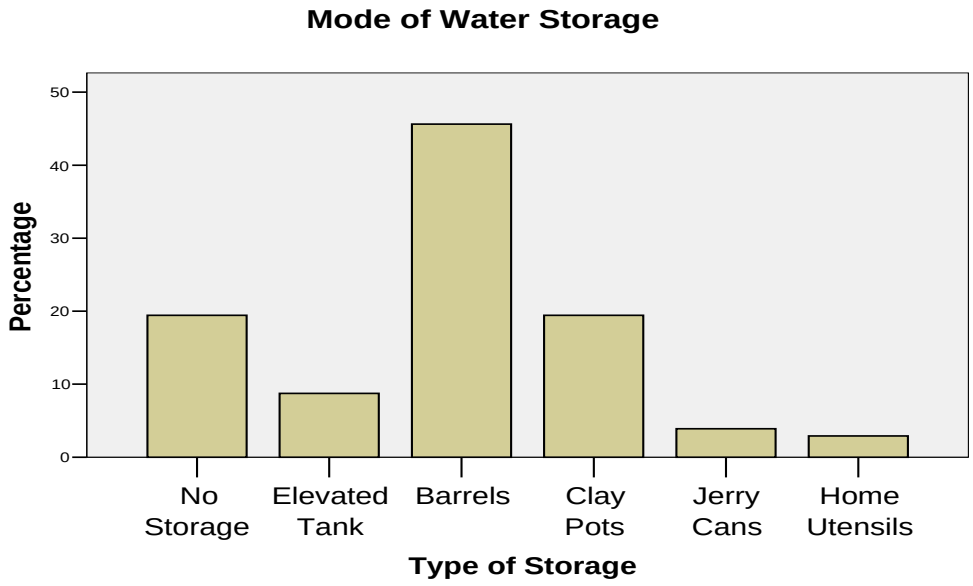


Figure (4)

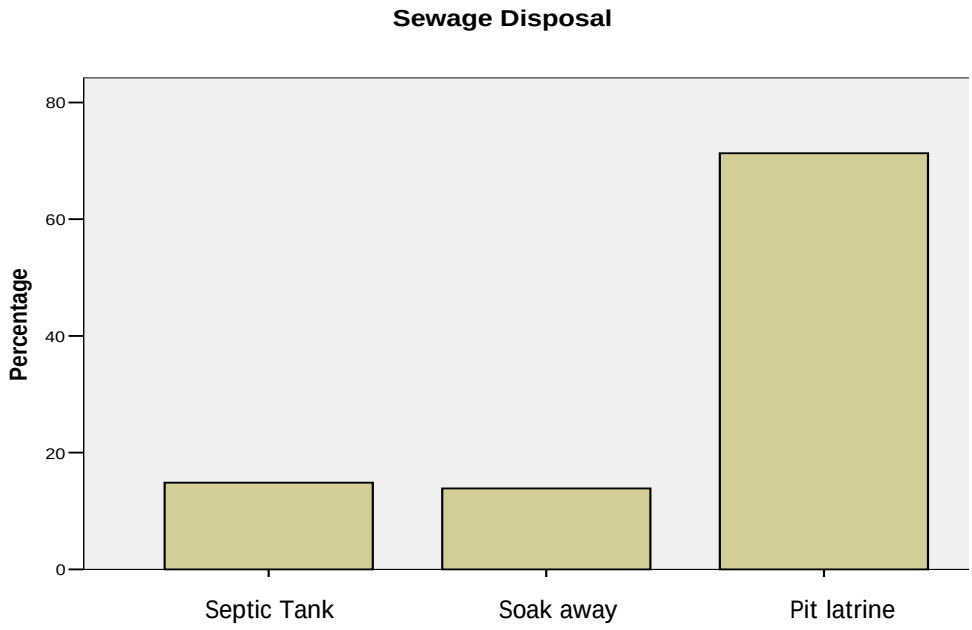


Figure (5)

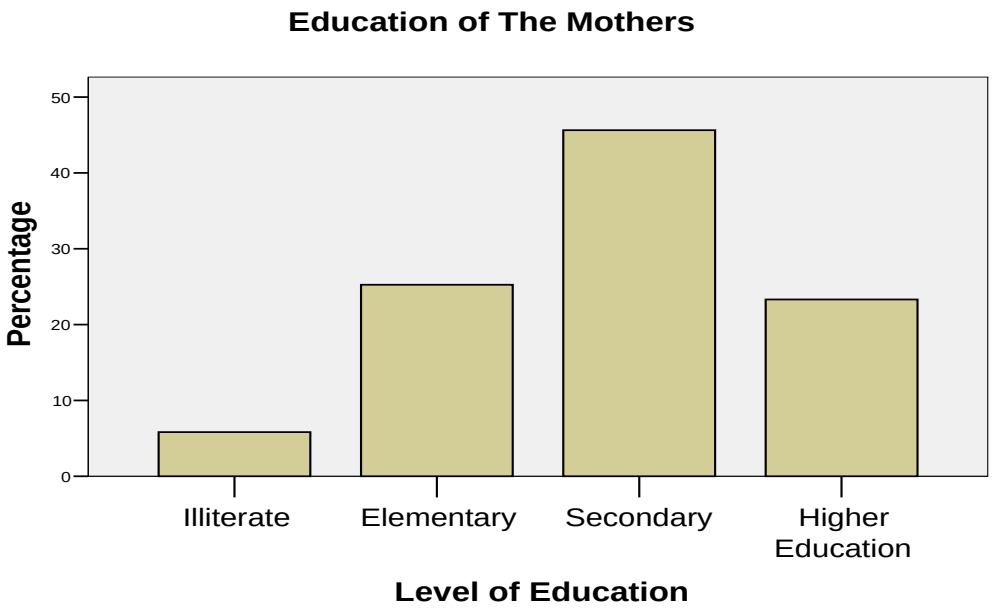
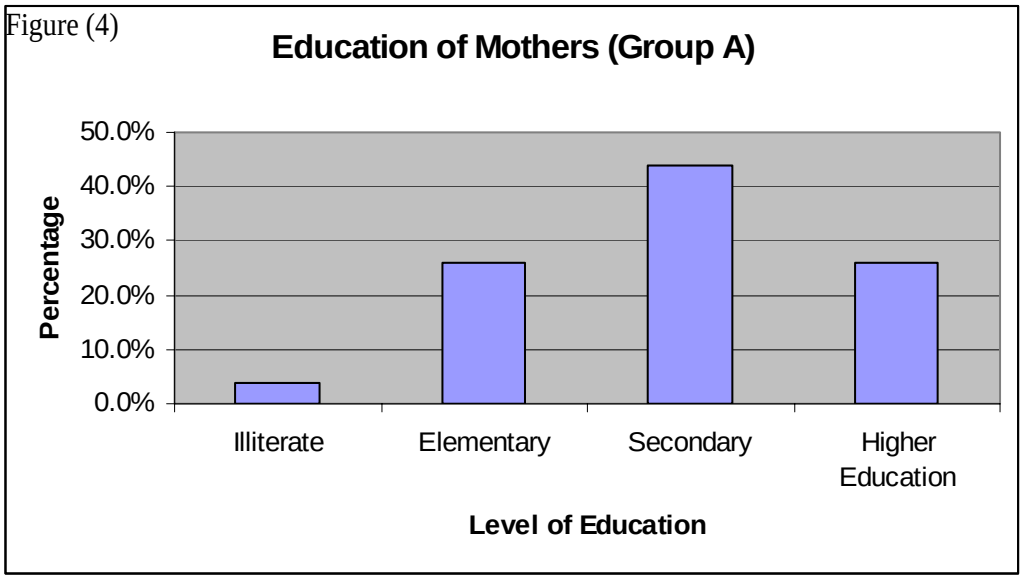


Figure (6)

Figure (4)



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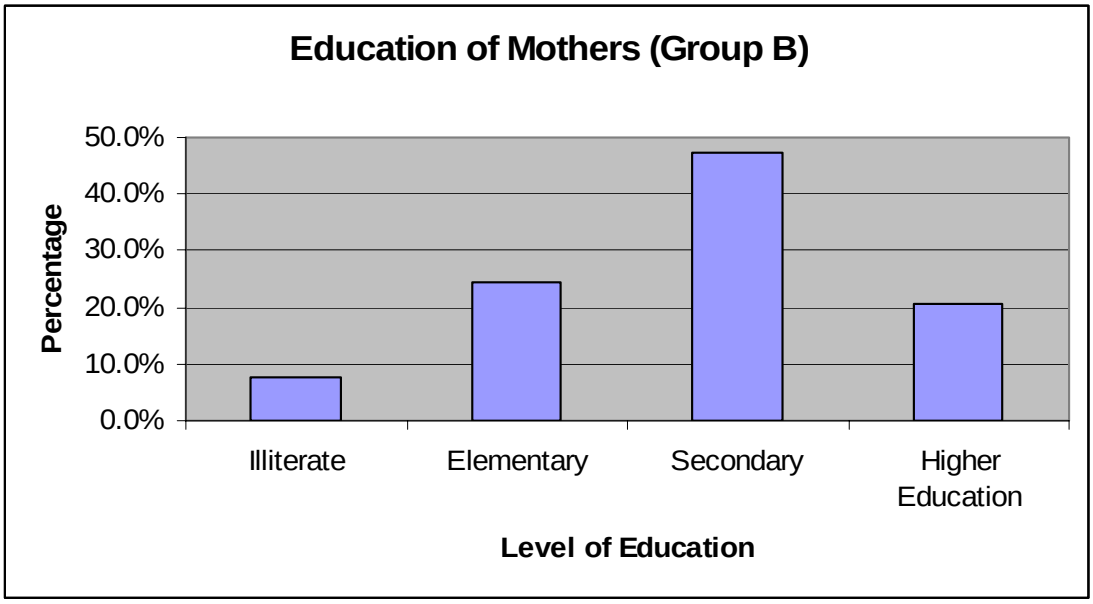

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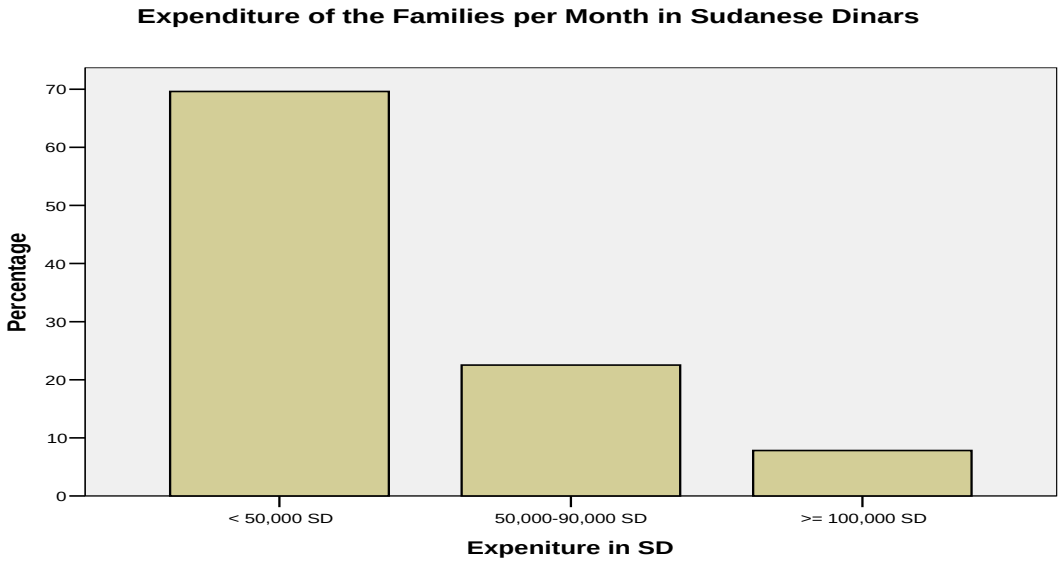

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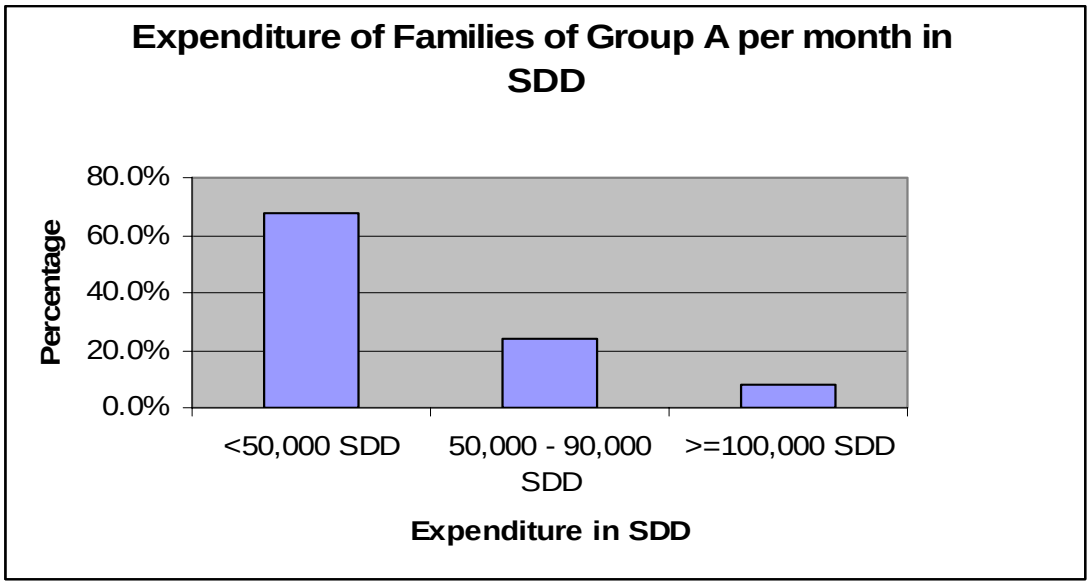

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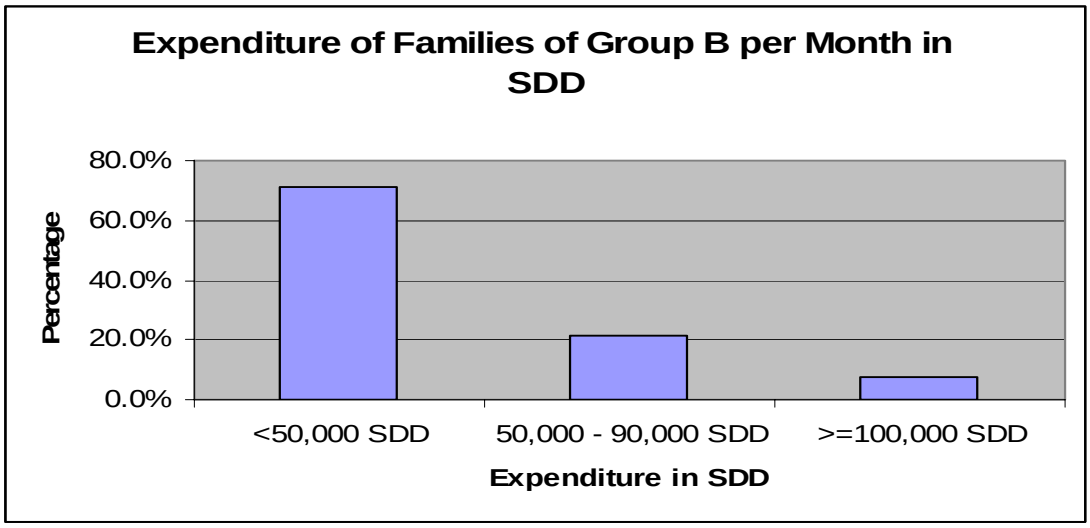

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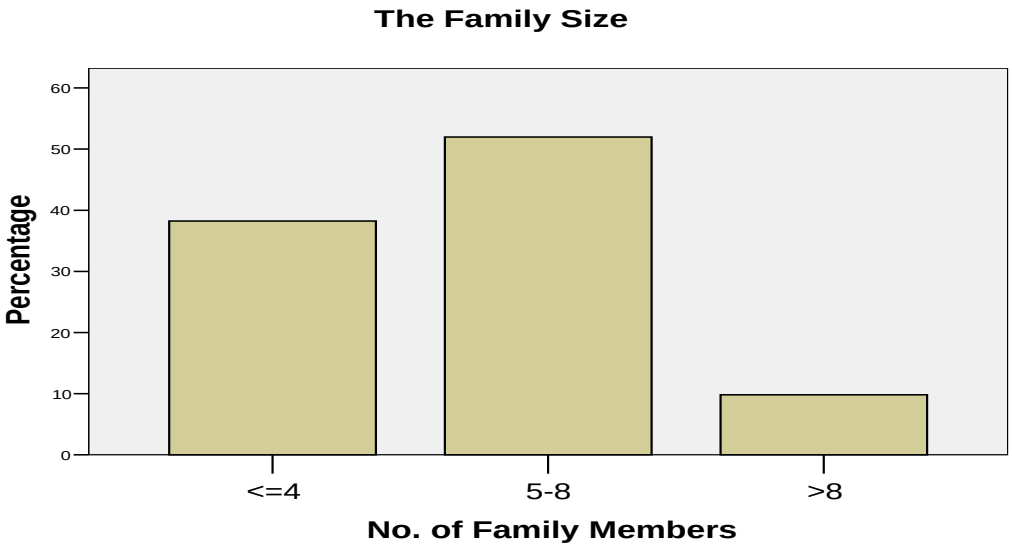
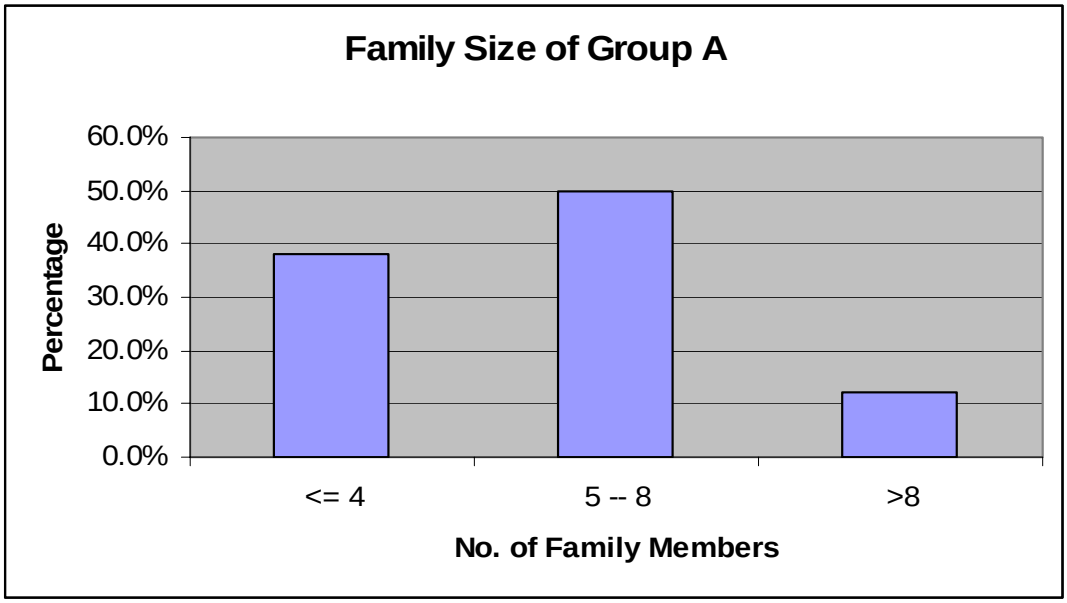


Figure (12)



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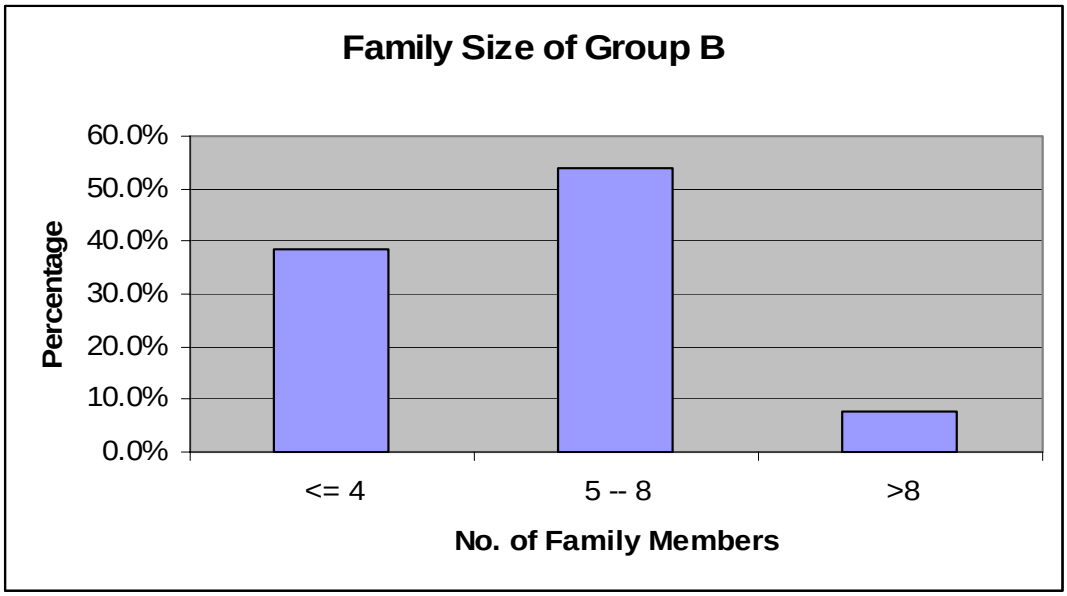
Family Size of Group B
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
Percentage
<= 4
5 -- 8
>8
No. of Family Members

4. DISCUSSION, CONCLUSION AND RECOMMENDATIONS

4.1 Discussion

An appropriate feeding practice is essential for the survival, growth, development and health of infants. There is consensus that infants must be exclusively breastfed but the duration of it has been of great debate. Most of the debate now is whether to exclusively breastfeed infants for four months or to extend the duration for six months. The risks of extending the duration of exclusive breastfeeding (EBF) are mainly faltering of growth and deficiencies of micro-nutrients such as iron. On the other hand increasing the duration of exclusive breastfeeding protects infants from chronic diseases and infectious diseases. So the main goal of this study was to investigate the effect of extending the duration of exclusive breastfeeding to six months on the growth and hemoglobin concentration of infants in Khartoum State.

The World Health Organization (WHO) defined exclusive breastfeeding as the practice of giving breast milk only. The other fluids such as water, formula milk, juices, semi-solid food and solid food are not allowed. The definition of exclusive breastfeeding should be known to all health authority sectors and to health providers in order to implement the practice in the country and community. Most of the population misunderstands exclusive breastfeeding as the practice of not giving water but all other fluids are allowed. The objective of the study is to test the new practice adopted by the Federal Health Authority of exclusive breastfeeding for six months against the old practice of exclusive breastfeeding for four months.

The assumption is that the idea of exclusive breastfeeding for four months, which had been adopted by the health authorities and health providers for ten years, should have a solid ground in the whole population. But in reality this hasn't taken place. The old declaration of exclusive breastfeeding for four to six months adopted by the Health Authority in the Sudan since 1992 is not being advocated by many doctors and health providers. The consequence of this is that the new declaration of exclusive breastfeeding for six months is rejected by many doctors and paramedical sectors. This study has been faced from the start by the fact that most of the mothers did not accept the idea and they refused to participate in the study. Some of the doctors and health providers are even ignorant about the policies of the Federal Health Ministry regarding exclusive breastfeeding and infants feeding practices adopted by the nation. So the main obstacle to this study had been the contradicting information given by the doctors to the lactating mothers.

This study started in the summer season, the hottest time of the year, so some doctors and some health providers instructed the mothers to give water to infants in addition to breast milk. It is known that 88% of breast milk is water and thus the health providers and mothers should have realized that the infants need only to be breastfed whenever they feel thirsty or hungry. At the same time breast milk is low in solute concentration. So the infants do not need much water as that is needed by older children or adults. The water in breast milk exceeds the water requirement in normal environment and is adequate even in the hottest dry environment. This fact is proven by the study group which continued exclusive breastfeeding during the hottest time of the year and no infant suffered from dehydration or needed fluid other than breast milk. So in order to spread the word of exclusive breastfeeding among the community, the health authority, the health providers and the key persons in all the

community need to be convinced and committed to the practice. If this is implemented by the health authority, all the health providers will be talking the same language and the mothers would be given the same instruction whenever and wherever they go. For this reason, the mothers who accepted to participate in the study were young and new mothers who had either one or two children. A strong motivation of these mothers for joining was that they wanted to benefit from the extended medical care and advice. The older mothers who had already raised many children thought that they had enough experience and they did not need to be told about how to feed their infants. This belief made the selection of the study group very difficult and took a whole month to complete. In a similar situation in Ghana, the health authority reached the fact that to implement the practice of exclusive breastfeeding an “Old Mothers and Grandmothers’ Club” was established. This idea helped to increase the numbers of exclusive breastfeeding mothers in the community. So in the Sudan a similar initiative is needed to convince the new mothers through the incorporation of the old mothers and grandmothers in the process of spreading the practice. Here the problem is not only extending the duration of exclusive breastfeeding from four months to six months, but rather the widespread acceptance of the practice of exclusive breastfeeding.

In the global statistics, the WHO estimated that six million lives a year were saved since the Declaration of the Protection and the Promotion Act of Exclusive Breastfeeding. The worldwide number of mothers who adopted exclusive breastfeeding increased three to four fold in the last decade and the global percentage stands at 39%. In contrast, this study group dropped to one fourth the initial number at the age of six months. The WHO estimates that the percentage of infants who are

exclusively breastfed for six months in the Sudan is very small (about 1%) and this could explain the high drop rate in this study group.

In this study the infants were selected using inclusion and exclusion criteria. The infants selected for the study were healthy with normal weights so that the results would not be confounded with the problems of small for date or preterm infants. The mean weight of all the infants in the study group was slightly higher than the mean weight of the population. The infants and their families were followed very intimately. The study programme workers had been very close to these families, giving medical care and advice all time until the end of the study period, and this close supervision could have affected the result. All infants who completed the duration of the study were healthy infants.

The same precaution was taken for the Hb concentration, the cut off point for the Hb concentration was 140 g/l more than - 2sd of the mean. This was done in order to avoid taking anemic infants in the study. But in spite of that, the mean Hb of the group is lower than the reference value which indicates that infants in the study are borne with low iron stores (low Hb concentration) and this can be explained by the fact that the nutrition of the mothers maybe the problem that should be addressed.

The study group had been followed up to the age of four months. At this time the nutrition status of the participating infants was assessed and compared with the reference population. The entire study group until the age of four months was exclusively breastfed and nothing was given to them. The infants had mean weight similar to the reference weight of the population and the length was also comparable to the reference. So as a global goal for optimum infant health and nutrition, all

mothers should be enabled to practice exclusive breastfeeding for at least four months.

The Hb concentration drops to lower levels, as usual in all infants, due to the rapid growth in the first year of life. But the study group had started with low mean of Hb concentration and so it reached lower levels. The mean Hb concentration at four months of age was lower than the reference mean of the population.

At the age of four months the study group was divided into two main groups. The division was done randomly by the computer. The mothers of infants in Group A were allowed to introduce food supplementation to their infants from the domestic food consumed by the families. The study programme did not interfere on the types or quantities of food given, and did not supply the families with food or money. The idea was to leave the choice of types and quantities of food administered to the eating habits of the household. For the purpose of measuring the intake quantities, the families were provided with standardized dishes, cups and spoons. Similar studies were conducted in Honduras to compare exclusive breastfeeding for six months with four months. These trials had insufficient power to detect any advantage of exclusive breastfeeding to six months because hygienically prepared foods were used for infants who were allowed food at four months of age.

The growth comparison was carried out between the main groups A and B. In comparing the two groups the mean Z- scores of Group A and Group B showed no significant difference and also the mean weights gained by the two groups in one month were almost identical. But the mean weight of Group A was slightly higher than group B, and Group A had a very high value of standard deviation. This indicated that the weights of infants in Group A were distributed in a wide range,

almost in a linear manner. While the infants in group B were clustering around the mean. The infants in Group A were the infants who were given food at the age of four and from the results it was found that their weights were affected by the family expenditure, type of food given and the education of the mothers. The high weights of infants are observed in highly educated mothers or in well to do families. The low weights of infants were more common in poor families and families of mothers with low level of education.

In group B the weights of infants had not been influenced by the level of education of the mothers or the family expenditure and all weights clustered around the mean. This indicated that the infants who were exclusively breastfed to the age of six months were not influenced by the environment surrounding them and grew steadily. They also did not suffer from faltering of growth. This had been proven by the risk ratio which indicated that exclusive breastfeeding to six months did not increase the risk of malnutrition more than the infants who were given supplementary food. A similar study was conducted in Dhaka, the capitol of Bangladesh, and the researchers found that exclusively breastfed infants' weights were comparable with the weights of supplemented infants. The researchers' ultimate conclusion was that food other than breast milk is not necessary. This result contradicted the result of another study conducted in Bangladesh also which came to the conclusion that exclusive breastfeeding for six months is not suitable for poor communities because of the low nutrition status of the mothers.

The infants at the age of six months showed no difference in the mean length between Group A and Group B. The measuring of length is known worldwide to be very difficult in infants because of their posture. This difficulty was aggravated by

taking the measurements while they were lying down and stretching their lower limbs. The measurement had been taken to the nearest 0.5 cm and a great effort was made to make it accurate but most probably these causes lead to the variation in lengths. At this age of six months the length gained by Group B is ½ cm higher than the length gained by Group A and this was significant. The mean Z scores of length –age for Group A and Group B showed no significant difference. The infants who have length <-2 Z score in Group B were four and there was no infant with this low length in Group A. So there was some risk for the infants exclusively breastfed for six months to be stunted compared to those supplemented by food according to this study and this result could not be explained.

The parameter weight- length is used to determine the nutrition status in the population when the age is not known. Using this parameter the infant nutritional status can be assessed regardless of the age. The infants would be classified whether they are light or heavy for their lengths.

The mean Z- scores of weight-length for Group A and Group B showed no significant difference. The chi square test was used to detect the relationship between exclusive breastfeeding for six months and being light in weight. The result showed that exclusive breastfeeding did not cause any lightness in the infants. There was also no increased risk of malnutrition. This indicates that there is no relationship between low weight-length incidences and the duration of exclusive breastfeeding for four or six months.

The outcomes of growth indicators studied showed that there were no significant difference in growth between infants exclusively breastfed for six months and those exclusively breastfed for four months only. Thus the introduction of food

supplements at early age as four months did not improve the growth of infants to noticeable levels. Some studies carried out in India and other developing countries showed similar results and also reached the fact that early introduction of food increased the prevalence of morbidity and mortality. This is a research area for study in the Sudan.

The infants in Group B at four months of age were divided into two Groups BFe and BPb which were given Ferrous Sulfate and placebo respectively, while both sub-groups continued exclusive breastfeeding up to six months of age.

At the age of six months the Hb concentration of Group A, Group BFe and Group BPb were similar in concentration and showed no differences. This result was odd because Group BFe had been supplemented by iron (20 mgs/day) which was equivalent to the daily requirement for the infant for two months. The mean Hb concentration of these infants showed no difference from the infants who were exclusively breastfed for six months and were not given iron supplement. But the whole Group of BFe was having Hb concentration higher than the two other groups. The expectations were to have results better than this, but this could be explained in two ways either the mothers were not consistent in giving the supplement or the iron supplement was not properly absorbed. In order to correct this problem, the ferrous sulfate syrup, which was given to the infants, contains an acidic factor to facilitate the absorption. But the presence of milk only in the stomachs of those infants might be the cause of mal absorption. The fact remains that the infants did not benefit from the iron supplement.

The infants in Group A who were given food supplementation showed Hb concentration similar to those exclusively breastfed for six months without any

supplementation, this means that introduction of food did not improve the Hb concentration of the infants. This fact is demonstrated when comparing the means of Hb concentration of the three groups which showed no significant differences. But the means of the three groups were significantly lower than the reference mean of Hb concentration at the age of six months. The reason for this result may be the low Hb concentration of the infants at birth which continued to the age of six months. The researchers of the Honduras clinical trials suggested that exclusive breastfeeding for six months could compromise Hb in the infants, but here in this study exclusive breastfeeding for six months was not the problem.

The risk of having Hb concentration less than – 2 sd below the reference value is almost similar in the three groups and the problem of Hb concentration is facing those infants from the date of birth. The infants generally had low Hb concentration for the whole period of the study regardless of the intervention that was used. The problem of low levels of Hb concentration had started from birth. So the nutrition status of the Sudanese mothers is the problem that needs to be considered and studied. The iron supplement with exclusive breastfeeding did not improve the Hb concentration and thus the thinking should be on the type of intervention to be done before birth. Some studies conducted in developing countries like Chile and Honduras suggested that, where the women iron stores could be suboptimal, exclusive breastfeeding for six months may compromise Hb concentration of the infants. The results of these studies were consistent with the result of this study which stated that the primary cause of anemia was the low Hb concentration at birth

The environment surrounding the infants in this clinical trial had some impact on them. There were many factors to be studied but here the infants' weights and Hb

concentration were studied in relation to the education of the mothers, the family expenditure and the family size. The comparisons were done between classes within the groups and between the groups to detect the differences.

When studying the education of the mothers in Group A, it was found that the weights of infants were affected. The infants of illiterate mothers had low weights compared with high education levels or secondary levels and this might be due to better care to the infants from the educated mothers although the food consumed by the infants showed no difference between the levels of education. Studying the education in Group B showed no difference in weights of infants between the various levels, which indicated that the mothers can manage to exclusively breastfeed their infants and reach weights comparable with the reference weight at the age of six months regardless of their levels of education.

Comparing the levels of education between the two groups revealed no differences, and the illiterate mothers continued to have infants with low weights but exclusively breastfed infants were better than those given supplementary food, while the mothers with high education had infants with larger weights in both the supplemented or the exclusively breastfed for six months. The Hb concentration had not been affected by the education of the mothers and all levels in the various groups showed the same result of low levels of Hb concentration.

The expenditure of the families was determined by what the mothers spent for their families' daily needs. The family expenditure was found to be a simple and direct way for assessing the economic status of the families. The weights of infants were affected by the family's economic status. This could be realized in Group A whose infants were allowed to have food at the age of four months. In this group the

weights of infants whose families spent less than 50000 Sudanese Dinars were lighter than the higher expenditure classes. The infants in this class were given small amounts of food with small quantities of protein, carbohydrates and calories. This usually happens at the expense of breast milk. The infants in the upper class had better weights and had been given more protein, carbohydrates and calories. The infants in the low expenditure classes of Group B had lower weights than the other groups and so the poverty of these families affected their ability to exclusively breastfeed their infants successfully. In comparing the low classes in both groups A and B the mean weights showed no difference, and the infants of the two groups had low weights. So in this class exclusive breastfeeding for six months did not decrease the weights more than when food was introduced. As long as food did not improve the growth of these infants and the amount of it was small then exclusive breastfeeding could be the best for these disadvantaged families. So the mothers of the low expenditure class in this study were similar to the mothers in Bangladesh poor communities had low nutrition status. And so in order to exclusively breastfeed their infants, they need proper information, support and counseling.

When the mean Hb concentration of infants of family expenditure classes within Group A was compared, it was found that the infants were similar in the low and high classes. The same was true for Group B and its two sub groups. But when the Hb concentration of infants of various classes in the two groups was compared there appeared a difference in infants of the same class. The Hb concentration of infants in the middle class of Group A showed higher Hb levels than infants in the middle class of Group BFe and Group BPb, which were exclusively breastfed for six months with and without supplementation respectively.

The infants' weights had been compared in various family size categories but no difference could be found. The weights and Hb concentration of infants in small families or large families were similar and were not affected by the family size. The infants who lived in large families were taken care of comparable to those in small families and the study could not detect any difference in growth or Hb concentration in various family settings.

Limitations

1/ There was great difficulty in confirming the total compliance of the parents to exclusive breastfeeding for the required period of the study. There was no test or investigation to confirm or exclude the compliance of the mothers. So the compliance to exclusive breastfeeding was checked by the sudden home visits to the families (twice a month) and by the episodes of diarrhoea. The episode was investigated to determine the cause, to ensure compliance and treat the infant.

2/ the compliance of the mothers to provide the daily dose of iron supplementation for their infants were also difficult to confirm. The only way to check the compliance was to detect the amount of syrup in the bottle from time to time.

3/ There had been some difficulty in collecting information about food quantities and types which were offered to the infants.

4/ There are different ways of cooking food. So the composition of each item differs according to the way it is cooked. This leads to difficulties in analyzing food types and thus inaccuracy in composition of some items.

4.2 Conclusions

- ✓ Exclusive breastfeeding for six months did not cause faltering of growth of infants in this study in comparison with reference growth rates.

- ✓ Exclusive breastfeeding for six months lead to growth patterns comparable to exclusive breastfeeding for four months and followed by food supplementation thereafter. Therefore it is appropriate to stay with exclusive breastfeeding for six months.

- ✓ The growth of infants who were exclusively breastfed for six months was not influenced by the level of education of the mothers, while the growth of infants to whom food was introduced after four months was affected by the levels of education of the mothers.

- ✓ The magnitude of family expenditure has an impact on the rate of growth of the infant whether he is exclusively breastfed for four or six months. The infants of the families in the low income class had smaller rates of growth of weights than infants in the higher income classes.

- ✓ The size of the family of the infant did not have an effect on the rate of growth of the infants in this study, whether the infants were exclusively breastfed for six months or were given supplementary food at four months.

- ✓ The Hb concentration of the infants in this study group at birth was in average lower than the reference value, a phenomenon which indicated lower iron stores of mothers.

- ✓ The six-month Hb concentration of the infants, who were exclusively breastfed for six months and not given iron supplement, was similar to the Hb concentration of infants given food supplementation after four months. Therefore, the supplementary food does not have any positive influence on the Hb concentration.

- ✓ The infants who were exclusively breastfed for six months and given iron supplement had Hb concentration levels which were slightly better than the other groups, but the level was still lower than expected and so further studies are needed in this area.

4.3 Recommendations

1. The doctors and the health providers have to be well informed about the Federal Health Ministry policies and directives regarding exclusive breastfeeding for six months in the Sudan.
2. The Federal Health Authority should seek ways of implementing its policies and ensuring that the personnel in the entire health sector are complying with it.
3. Exclusive breastfeeding for six months should be promoted as the best feeding practice for every expecting mother, especially the ones belonging to disadvantaged families. This should be the message that should reach every lactating mother and then she can be given the chance to choose.
4. The various communications media should be employed to spread the word of exclusive breastfeeding among the entire population in order to help the mothers understand its benefits and to accept the idea.
5. Mothers, fathers and other caregivers should have access to objective, consistent and complete information about the recommended period of exclusive breastfeeding and continued breastfeeding; the timing of introduction of food, the types of food and the amount of food that should be given.
6. The idea of the *Grandmothers' Exclusive Breastfeeding Clubs* in the local communities should be promoted in order to convince the old mothers to accept the practice and in turn help the young mothers to exclusively breastfeed their infants.

7. The iron supplement should be provided free of charge to all pregnant women to ensure that the mothers will have good iron stores so that the neonates will have better Hb concentration levels at birth.

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Annex 1

استبيان الرضاعة الطبيعية المطلقة

رقم الإستمارة ☐ كرت متابعة رقم

تاريخ الإستبيان ☐ / /٢٠٠٥م

(١) اسم الطفل ☐ (٢) نوع الطفل ذكر ☐١ أنثى ☐٢

☐

(٣) تاريخ الولادة ☐ / /٢٠٠٥م

(٤) وزن الطفل عند الولادة ☐ كجم (٥) طول الطفل عند الولادة ☐ سم

---

(٦) اسم الأم ☐ (٧) العمر ☐ سنة

(٨) مكان السكن: حي ☐ محلية ☐ معتمدية ☐

(٩) المستوى الأكاديمي

☐١ أمية ☐٢ أساس ☐٣ ثانوي ☐٤ جامعي ☐٥ فوق الجامعي

☐

(١٠) عدد الولادات بما فيهم الطفل موضوع الدراسة .....

☐

(١١) كيفية الرضاعة للولادات السابقة:

	الطفل	نوع الرضاعة	نوع السوائل أو الطعام	سبب الرضاعة غير المطلقة
١				
٢				
٣				
٤				
٥				
٦				
٧				
٨				
٩				
١٠				

(١٢) هل سمعت بالرضاعة الطبيعية المطلقة من قبل ؟

☐

١☐ نعم ٢☐ لا

(١٣) هل إلتزمت بها من قبل إلتزاما كاملا ؟

١☐ نعم ٢☐ لا

☐

(١٤) هل تعمل الأم خارج المنزل بعيدا عن طفلها ؟

١ نعم ٢ لا

(١٥) إذا كانت الإجابة نعم بعيدا عن طفلها، ما عدد ساعات عمل الأم يوميا خارج المنزل

١ ١- ٤ ساعات ٢ ٥- ٨ ٣ ٩- ١٢ ٤ اكثر من ١٢

---

(١٦) اسم الوالد

(١٧) المستوى الأكاديمي

١ أمي ٢ أساس ٣ ثانوي ٤ جامعي ٥ فوق الجامعي

(١٨) مقدار ما تصرفه الأسرة في الشهر أو اليوم جنيه.

(١٩) عدد أفراد الأسرة .....

(٢٠) المنطقة السكنية

١ عشوائي ٢ تنظيم قرى ٣ درجة ثالثة ٤ ثانية ٥ أولى

(٢١) عدد الغرف في المنزل

١ غرفة ٢ غرفتان ٣ ثلاثة اربع ٤ ٥ أكثر

(٢٢) مصادر المياه

١ مباشرة من الماسورة ٢ شراء بالبرميل

(٢٣) الإستهلاك اليومي للماء بالبراميل .....

(٢٤) تخزين الماء

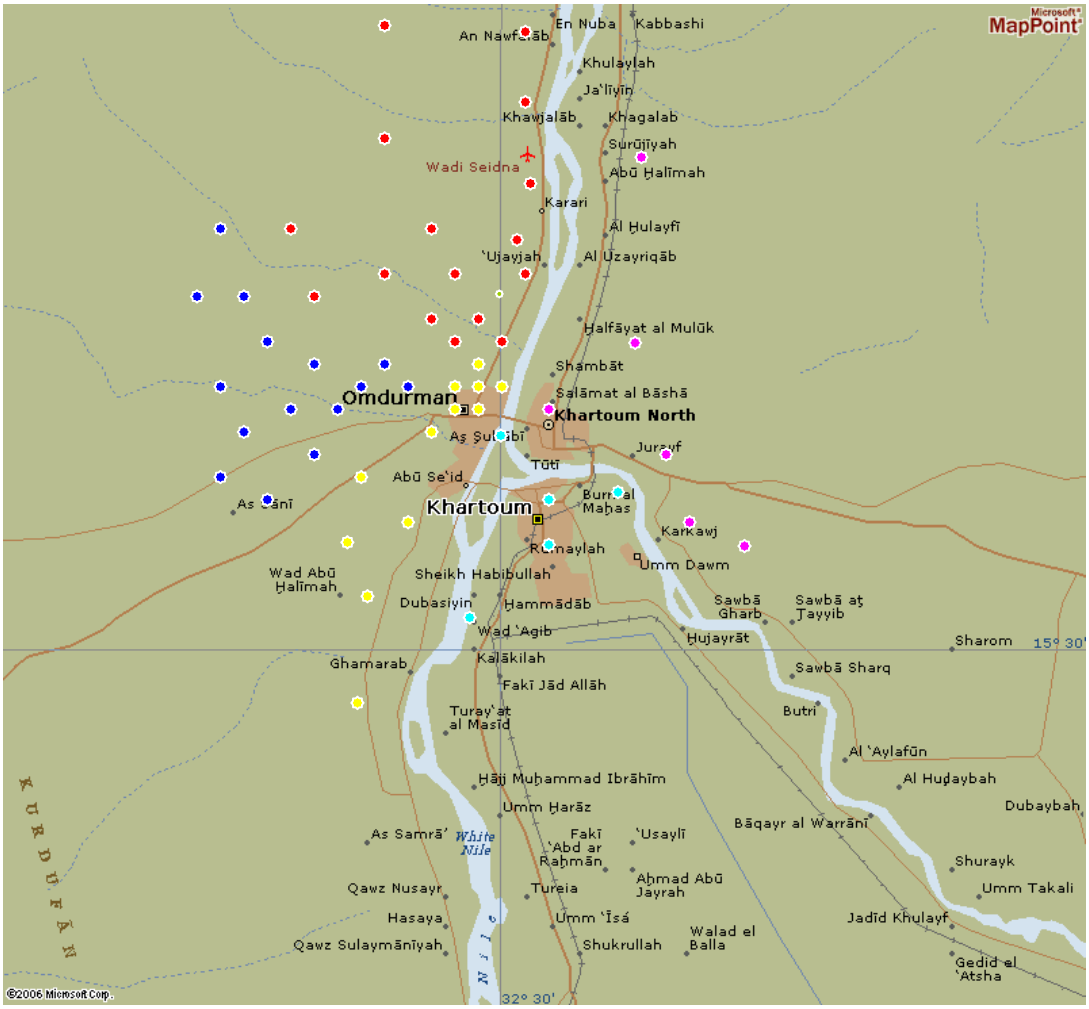
١ صهريج ٢ براميل ٣ أزيار ٤ جركانات ٥ أدوات منزلية

(٢٥) الصرف الصحي

١ سايفون ٢ مصاص ٣ حفرة بلدية ٤ العراء

Annex 2

Distribution of Follow-up Health Centers in Khartoum State



KEY

Umbadda Locality		Omdurman Locality		Khartoum North	
Karrary Locality		Khartoum Locality			

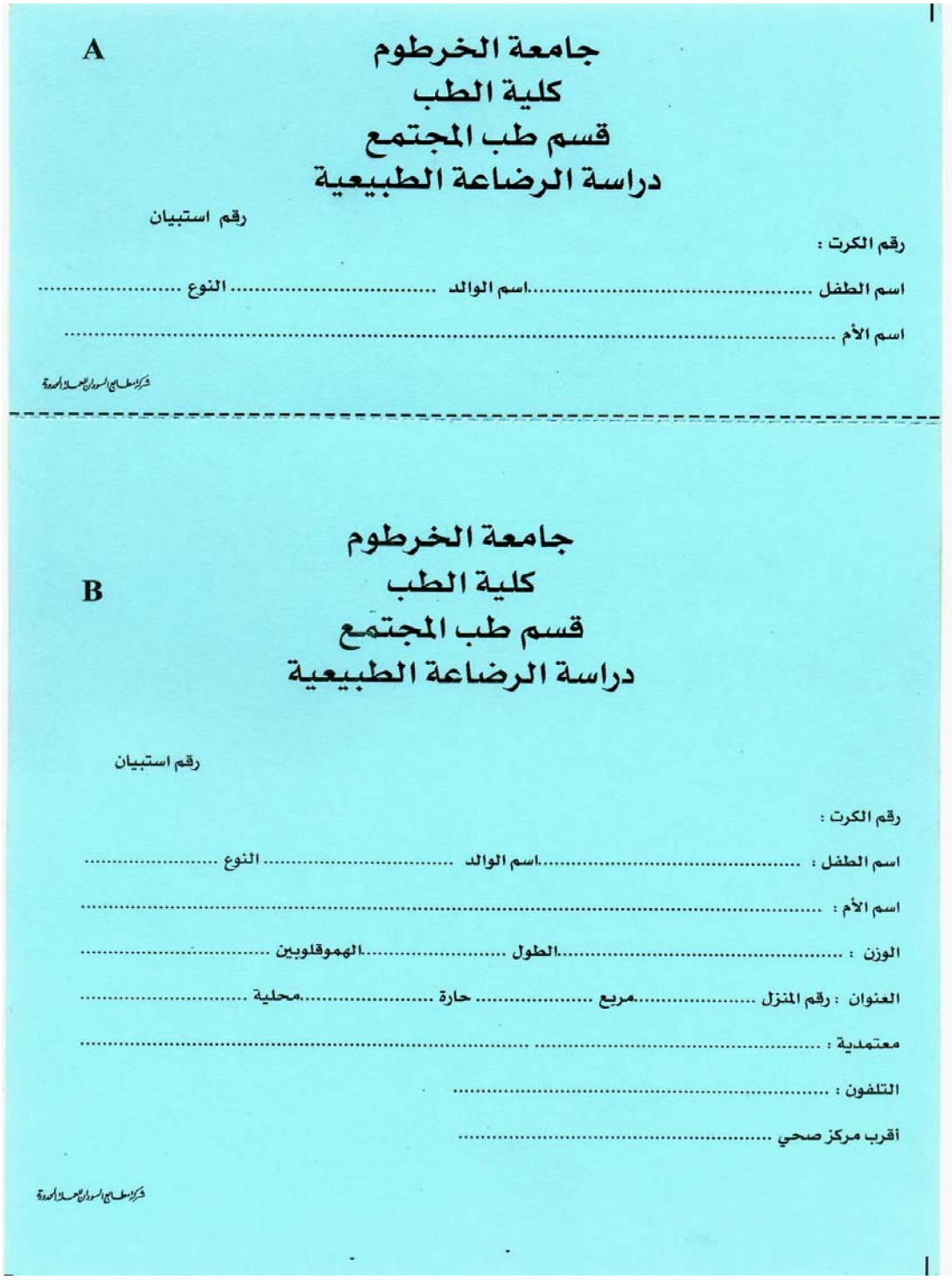
Annex 3

Reference HeaAlth Centers for Measurements In Khartoum state

- ✓ Abu Zumam Alkabashi Health Center
- ✓ Alrakhaa Hospital
- ✓ Almanara Health Center
- ✓ Sharwani Health Center
- ✓ Althawra Health Center
- ✓ Aldaw Hajooj Health Center
- ✓ Wad Nubawi Health Center
- ✓ Aldroshab Health Center
- ✓ Alsagana Health Center
- ✓ Toti Health Center

Annex 4

Identification Card



A

جامعة الخرطوم
كلية الطب
قسم طب المجتمع
دراسة الرضاعة الطبيعية

رقم استبيان

رقم الكرت :

اسم الطفل .....اسم الوالد ..... النوع .....

اسم الأم .....

شركة مطابع السودان للعملة المحدودة

B

جامعة الخرطوم
كلية الطب
قسم طب المجتمع
دراسة الرضاعة الطبيعية

رقم استبيان

رقم الكرت :

اسم الطفل : .....اسم الوالد ..... النوع .....

اسم الأم : .....

الوزن : .....الطول .....الهموقلوبين .....

العنوان : رقم المنزل .....مربع ..... حارة .....محلية .....

معتمدية : .....

التلفون : .....

أقرب مركز صحي .....

شركة مطابع السودان للعملة المحدودة

Annex 5

List of Collaborators In Khartoum State

1\ Staff in Omdurman Maternity Hospital:

A- Medical Doctors:

- Dr. Hani Muhamed
- Dr. Muhamad alhafiz
- Dr. Muhamad Abdullah

B- Matron:

- Matron Suad Othman

C- Nurses:

- Haleema Idris
- Khalda Gasm Elseed

2\ Dietitians who located families' homes:

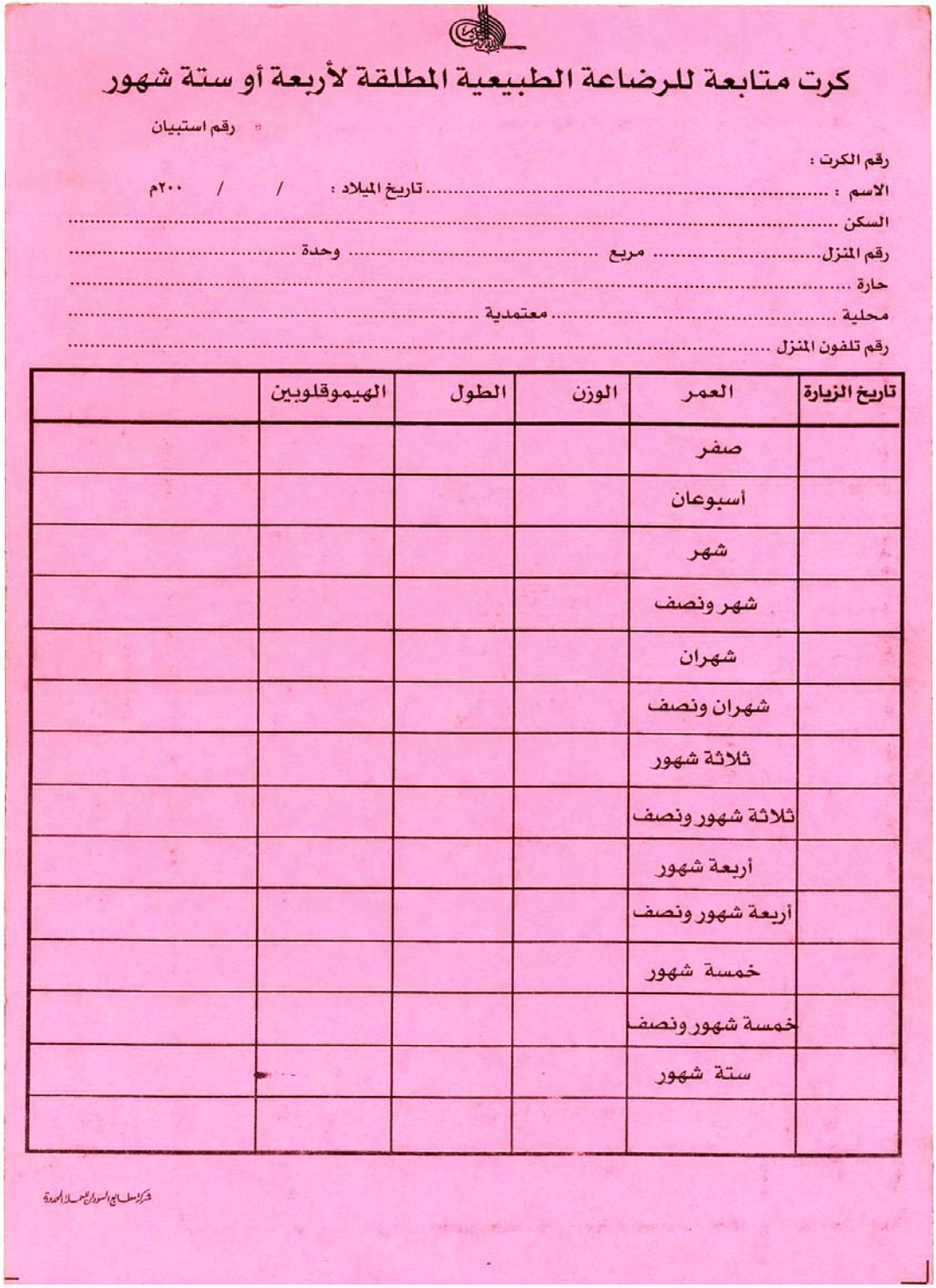
- Ibtisam Abu Elgasim
- Masha'ir Yasin
- Huwaida Muhamad
- Samia Elsadig
- Sit Noor
- Samia Awd Elseed
- Um Kalthoom Omer
- Rehab Adam
- Rehab Ibrahim
- Rajabia Suliman
- Maysaa Ibrahim
- Badria Abd Elnabi

3\ Regional Nutrition Officers:

- Afraa Abas - Omdurman
- Zuhoor Hamdan - Umbadda
- Intisar Muhammad Khaleefa - Gebel Awlia
- Insaf Magzoub - Karary
- Awatif M. Abdallah - Khartoum
- Samah - Khartoum North
- Muhammad Ishaag Mahmoud – East Nile

Annex 6

Follow Up Card (A)



كرت متابعة للرضاعة الطبيعية المطلقة لأربعة أو ستة شهور

رقم استبيان

رقم الكرت :

الاسم : ..... تاريخ الميلاد : / / ٢٠٠م

السكن .....

رقم المنزل..... مربع ..... وحدة .....

حارة .....

محلية ..... معتمدية .....

رقم تلفون المنزل .....

تاريخ الزيارة	العمر	الوزن	الطول	الهيموقلوبين	
	صفر				
	أسبوعان				
	شهر				
	شهر ونصف				
	شهران				
	شهران ونصف				
	ثلاثة شهور				
	ثلاثة شهور ونصف				
	أربعة شهور				
	أربعة شهور ونصف				
	خمسة شهور				
	خمسة شهور ونصف				
	ستة شهور				

شركة مطابع السودان للعملة المحدودة

Follow Up Card (B)

الوجبات الغذائية الإضافية من عمر (٤ - ٦) شهور.

نوع الأكل	الزيارة الأولى		الزيارة الثانية		الزيارة الثالثة		الزيارة الرابعة	
	عمر ٤ شهور و نصف		عمر ٥ شهور		عمر ٥ شهور و نصف		عمر ٦ شهور	
	النوع	الكمية	النوع	الكمية	النوع	الكمية	النوع	الكمية
البروتين								
الكربوهيدريتات الدهون								
الخضر								
الفواكه								

Annex 7

Food Composition in Terms of 100 gms Edible Portion
Sudanese Food

	PROTEIN	CARBO.	FATS	ENERGY	Fe./mg
EGG	14.4	0	15.6	203	
LENTILS	26.2	61.6	0.8	348	10.8
BEANS	9	9.8	0.3	74	1.5
MEAT	22.9	0	2.5	120	2.9
POTATOS	2.5	16.1	2	89	
CARROTS	0.8	10	0.1	41	1.8
MILK	3.4	4.6	4.9	75	0.2
YOGHURT	3.8	13	3	94.2	0.2
RICE	2.8	38.4	7.8	234	
ORANGE	0.8	7.5	0.6	26	0.6
BANNANA	1.2	23.1	0.1	88	1.7
SHARMOUT	8.6	7.8	2.9	88.6	0.6
ASSEEDA	2.4	17.1	0.2	73	0.2
PUMPKIN	2	7.6	5.9	89	2.4
KEESRA	5.8	42.5	0.3	180	1
BISCUITS	8.4	74.8	10.3	430	1
BREAD	8.4	57.3	0.3	261	2.2
OIL	0	0	100	884	0
CHEESE	21.6	13.1	27.9	388	4.9
SWEET POTATOES	0.7	16.2	0.2	69	1.3
SOUP	0.33	0.08	0.05	0.35	0.05
SUGER	0	99.9	0	387	0.01
CUSTARD	2.7	21	4.2	133	
WHITE BEANS	6.4	8.5	2	74	0.5
GRAPEFRUIT	0.5	10	0.1	28	0.8
GUAVA	0.7	9.8	0.1	38	1.5
APPLE	0.2	19.9	0.3	75	0.8
CERELAC	15	69.8	9	379	7.5
RIGLA	3.9	12	2.4	81	4.3

Annex 8

Hb concentration, weight and Length of Infants

Group A

CARD No.	Hb g/l			Wt/kg			Ht/cm		
	birth	4 month	6 month	birth	4 month	6 month	birth	4 month	6 month
105	18	10.3	8.1	3.1	7.2	8.3	52	66	68
114	17.1	9.4	8.6	3	6.9	8	52	67	71.5
120	15.8	17.1	14	2.7	6.6	7.3	60	67	70
126	16.3	10.3	10.7	3.6	6.8	7.4	51	64.5	67.5
128	18	13	15	3.2	6	6,3	48	60	63
139	13.3	9	9.8	3.4	5.6	7.2	52	67	69.5
141	15.4	12		4.2	6	8.3	57	67.5	69.5
159	16.7	10.3	10.3	2.9	5.3	5.8	50	67	68.5
161	18.8	11.1		4	7.4	8	65	66.5	70
162	15.4	11.3		4	7.4	8	54	63	68
173	18	10.3	9.8	3.5	6	6.5	52	65	67
182	12.5	11.6	10.7	4	7	7	50	66	67
185	16.8	8.5	9	3	6.5	7.1	53	62	65
195	19.3	11.1	11.1	3.4	6.4	8	55	64	69.5
198	23	11.6	9.4	3.5	5.5	5.8	50	66	67
201	18.4	9	12.4	3	6	7.8	50	62	63.5
205	12.4	17.1	9.8	3.8	6	6.5	53	65	66.5
229	15.4			3.2	7.1	7.3	49	68.5	70.5
230	18	10.3		3	5.7	6	53	67.5	67.5
234	17.1	12.8	7.3	2.5	5.7	6.2	48	59	62.5
248	15	10.3	11.1	3.6	6	7	51	63	64
252	17.1	9.4	8.5	3	6.5	7.8	51	65	68
263	19.3	9.8		3.6	8.5	9.5	58	68	74
285	20.5	11.1	9.8	3.4	6.1	6.8	51	63.5	67
286	18.4	13	12	3.3	6.7	7.1	52	67	72
316	15	12.8	12	3	7.7	10	47	66	67
319	15.8	8.5	10.3	3.3	6.3	7.3	50	65.5	68.5
324	18	11.1		4.3	5.9	6.3	53	65	66.5
328	18	9.8	11.6	3.2	7.1	7.6	48	62.5	65
329	18	9.8	10	2.5	6.8	7.5	48	67	70
338	18.3	12	13	4.6	7.8	8.2	54	63	67
345	17.1	8.1	11.1	3.2	7.5	7.5	50	66	66
346	18	11.6	6.8	3	6.8	6.7	52	63	70
366	16.3	9.4		3	6.2	6.9	45	61	68.5
372	15.8			4.2	6.75	7	57	65	70
380	16.7	12.8	12	3.2	6	6.8	50	62	69
381	14	10.3	7.9	3.8	6.6	7	53	68	74
382	16.7	10.7	12	3.6	7	7.2	51	63.5	68.5
387	16.7	12	11.1	3	6.3	7.3	49	62	66
393	15.8		10.3	3.8	7	7.7	53	66	68
394	17.5		10.3	3.5	7.4	8	49	63.5	71
414	18.8	9.8	12	3.5	9.5	8.3	51	69	67.5
420	17.1	9.8	9	3.5	5.6	6.8	52	61	65

Continue Hb concentration, weight and Length of Infants
Group A

CARD No.	Hb g/l			Wt/kg			Ht/cm		
	birth	4 month	6 month	birth	4 month	6 month	birth	4 month	6 month
421	17.1	11.6		4.5	7.8	9.2	52	67	72
422	19.3		11.3	3.8	8.2	8.9	50	72	74
433	17.5		11.1	4	7.5	9	53	69	69
443	17.3	10.3	10.3	3	6.1	6.6	46	62.5	63.5
455	19.3			3.5	6.7	6.5	47	64	67.5
456	19.3		10.3	3.1	4.5	6.1	47	63.5	67
481	15		11.1	3	5.4	6.6	49	60	64.5
484	17.1		10.3	3.5	6.4	7	51	66	67.5
488	18	12	10.7	4.1	8	8.5	55	67.5	68.5
496	17.5	9.6	8.6	3.1	6.1	6.1	48	62	63.5
497	17.5	9	12	3.2	7.1	8.2	51	63	68.5
498	17.3		12.8	3.5	7.9	8	52	67.5	71
503	16.5		10.7	3.8	6.5	7	52	67	68
504	18	12		3.4	6.9	7.5	51	65.5	67

Annex 9

Hb concentration, weight and Length of Infants
Group BPb

CARD No.	Hb g/l			Wt/kg			Ht/cm		
	birth	4 month	6 month	birth	4 month	6 month	birth	4 month	6 month
111	18.8	11.6	12	3	5.2	5.2	52	62	65
150	19.3	18.4	10.3	3.6	6	6.95	50	68	70
151	17.5	11.6	10.3	4	6.3	6.3	52	70	70
158	16.7	10.3	10.7	3.2	7.1	7.5	50	63	65.5
165	15	11.6		3.5	6.4	6.5	53	61.5	67
166	15.5	10.7	10.7	3.6	6.1	7.2	54	67.5	70
183	15.8		6.8	3.7	6.4	6.9	56	66	70
196	21	19.3	8.5	2.6	7.2	7.8	49	64	68
233	15.8	8.1	7.7	2.6	5.8	6.3	50	58	63.5
237	18.8			3.2	6.3	7.2	50	64.5	67
264	16.3	10.5	11.3	3.3	5.85	7.3	51	64	65
266	18.4		9	3.3	5	6	51	58	61
277	21	19.3	11.1	3.4	6.4	7.8	49	65	67.5
278	16.7	14.6	9	4.2	6	6.7	52	62.5	65.5
305	15.4	10.3		3	8	8.5	48	70	76
360	19.7	12.8	10.7	3.5	5.85	7	47	63.5	65
370	18.4			2.9	5.4	6.6	50	61	65
397	18.4			4	6.8	7	55	65	70.5
419	18.4	12.8	11.6	3.2	8	8.4	50	65	67.5
428	18.4	9.4		3.5	6.3	7.1	51	59.5	66.5
432	18.4	12.4	11.6	3	4.8	5.6	47	60	61.5
453	16.7			3.7	8.3	9.6	52	70	76
457	16.7	12		3.1	5.5	6.3	49	58	60
459	19.3		9.8	3	6.1	6.1	50	64	67
460	18.3	11.1	10.3	4	7.5	7.1	51	60	66
464	19.3			4.5	6.4	7.5	52	64	72
465	19.3	12.4	13.7	2.7	5.9	6.4	45	59.5	65
470	18.8			3	6.5	7.8	48	63.5	67.5
480	16.7	10.7	13.3	4.2	6.1	6.1	51	66	66.5
491	18.8			3.7	7.7	8.2		66.5	75.5
501	18.4		12.8	3.3	7.1	8.3	50	65	65.5

Hb concentration, weight and Length of Infants
Group BFe

CARD No.	Hb g/l			Wt/kg			Ht/cm		
	birth	4 month	6 month	birth	4 month	6 month	birth	4 month	6 month
115	15	12	10.3	3.1	7.8	8.3	52	69.5	72.5
119	17.1	6.8	10.7	3.5	8.2	8	52	63	69
130	17.1	11.6	9.8	4	5.7	6	52	65	66
136	15.4			3.5	6.9	7.1	51	66.5	67
149	14	11.1	9	3.2	6.4	7.1	47	63	66
160	15.4	11.6	11.6	3.3	5.5	5.9	50	65	68.5
181	15	8.5	10.7	3.5	6.2	7.8	53	68	69.5
189	16.3	12.4	10.7	2.6	5.1	5.2	49	59	61
210	15.8	11.1	9.8	3.8	6.8	8.5	54	63.5	70
216	19.7	10.6		3.4	6.8	8.5	51	63.5	69.5
236	18			3.6	6	6.5	52	60	65
238	16.7	9.8		3.5	7.8	8.8	51	60	68.5
260	17.1	10.7	10.3	4.2	8.15	9	54	67	71
265	14.6	9.8		3.5	6.3	7.1	52	62	65
309	16.3	19.3		4	8.1	9.5	52	70	72.5
312	14.6			3	5.4	6.5	49	63	68
317	17.1		9.4	3.6	7	7.6	49	66	69
325	18	14.6	10.7	3.2	6.3	6.5	48	64	66
335	15	11.6	9.4	3.5	6.5	7.5	51	62	69.5
349	13.3	11.6	11	4.1	9	9.4	55	75	82
361	19.3	10.7	11.1	3.5	6.6	7	51	63.5	66
379	18	12.4		3.5	6	7.5	51	65.5	67
384	14	11.6	9.4	3.9	8.5	8.5	53	70	72.5
426		12.8		3.5	6.2	6.7	47	65	68
462	19.3			2.6	5.8	7	42	63	67.5
468	17.5	9.8	11.1	3.5	5.45	6.8	51	67	70
479	17.5		10.3	4	8	9.5	52	71	76
486	18.4	8.6		4	8.5	7.5	51	67	74
494	19.7		11.6	4.1	7.5	8.5	54	61	74

VITA

Dr. Suad M. Ali was born on June 20, 1954 in the province of Aldewaem in the Sudan. She was awarded the education prize for the best results in the Sudan secondary school certificate in 1972. She was graduated with a bachelor of science in home economics from the University of Illinois at Urbana-Champaign in 1977. She graduated with Bachelor of Science in Medicine and surgery from the University of Khartoum in May 1981. She has been working in the Federal Ministry of Health since graduation. In 1985 she worked in Omdurman Islamic University and she was able to establish the health center in the female campus. She has been working in the Pediatric Emergency Hospital in Khartoum since 1989.

In 1996 she was able to pass MD Part One Pediatrics. She passed MD Part One Community Medicine in 2003.

Dr. Suad is a mother of five sons and a daughter, two of her sons are doctors and two of them are electrical engineers, and the two young offspring are students.